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View Safety Info

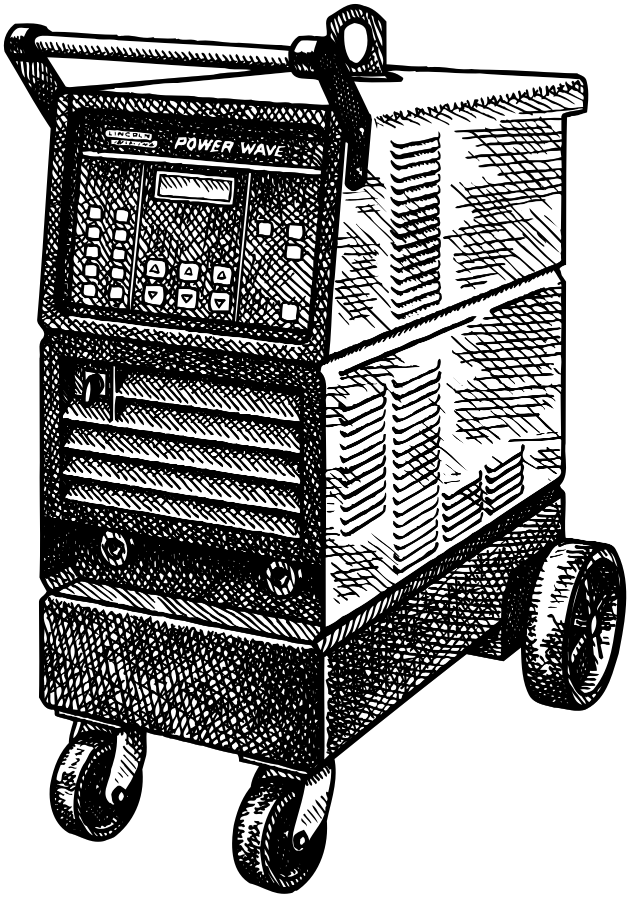
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SVM112-B

February, 2001

INVERTEC POWER WAVE™ 450

For use with machines having Code Numbers: **10105 thru 10610**



Safety Depends on You

Lincoln arc welding and cutting equipment is designed and built with safety in mind. However, your overall safety can be increased by proper installation . . . and thoughtful operation on your part. **DO NOT INSTALL, OPERATE OR REPAIR THIS EQUIPMENT WITHOUT READING THIS MANUAL AND THE SAFETY PRECAUTIONS CONTAINED THROUGHOUT.** And, most importantly, think before you act and be careful.

SERVICE MANUAL

LINCOLN® ELECTRIC

• World's Leader in Welding and Cutting Products •

• Sales and Service through Subsidiaries and Distributors Worldwide •

Cleveland, Ohio 44117-1199 U.S.A. TEL: 216.481.8100 FAX: 216.486.1751 WEB SITE: www.lincolnelectric.com

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WARNING

CALIFORNIA PROPOSITION 65 WARNINGS

Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.

The Above For Diesel Engines

The engine exhaust from this product contains chemicals known to the State of California to cause cancer, birth defects, or other reproductive harm.

The Above For Gasoline Engines

ARC WELDING CAN BE HAZARDOUS. PROTECT YOURSELF AND OTHERS FROM POSSIBLE SERIOUS INJURY OR DEATH. KEEP CHILDREN AWAY. PACEMAKER WEARERS SHOULD CONSULT WITH THEIR DOCTOR BEFORE OPERATING.

Read and understand the following safety highlights. For additional safety information, it is strongly recommended that you purchase a copy of “Safety in Welding & Cutting - ANSI Standard Z49.1” from the American Welding Society, P.O. Box 351040, Miami, Florida 33135 or CSA Standard W117.2-1974. A Free copy of “Arc Welding Safety” booklet E205 is available from the Lincoln Electric Company, 22801 St. Clair Avenue, Cleveland, Ohio 44117-1199.

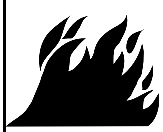
BE SURE THAT ALL INSTALLATION, OPERATION, MAINTENANCE AND REPAIR PROCEDURES ARE PERFORMED ONLY BY QUALIFIED INDIVIDUALS.

FOR ENGINE powered equipment.

1.a. Turn the engine off before troubleshooting and maintenance work unless the maintenance work requires it to be running.



1.b. Operate engines in open, well-ventilated areas or vent the engine exhaust fumes outdoors.



1.c. Do not add the fuel near an open flame welding arc or when the engine is running. Stop the engine and allow it to cool before refueling to prevent spilled fuel from vaporizing on contact with hot engine parts and igniting. Do not spill fuel when filling tank. If fuel is spilled, wipe it up and do not start engine until fumes have been eliminated.

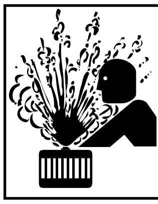
1.d. Keep all equipment safety guards, covers and devices in position and in good repair.Keep hands, hair, clothing and tools away from V-belts, gears, fans and all other moving parts when starting, operating or repairing equipment.

1.e. In some cases it may be necessary to remove safety guards to perform required maintenance. Remove guards only when necessary and replace them when the maintenance requiring their removal is complete. Always use the greatest care when working near moving parts.

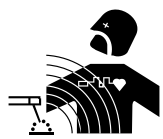


1.f. Do not put your hands near the engine fan. Do not attempt to override the governor or idler by pushing on the throttle control rods while the engine is running.

1.g. To prevent accidentally starting gasoline engines while turning the engine or welding generator during maintenance work, disconnect the spark plug wires, distributor cap or magneto wire as appropriate.



1.h. To avoid scalding, do not remove the radiator pressure cap when the engine is hot.



ELECTRIC AND MAGNETIC FIELDS may be dangerous

2.a. Electric current flowing through any conductor causes localized Electric and Magnetic Fields (EMF). Welding current creates EMF fields around welding cables and welding machines

2.b. EMF fields may interfere with some pacemakers, and welders having a pacemaker should consult their physician before welding.

2.c. Exposure to EMF fields in welding may have other health effects which are now not known.

2.d. All welders should use the following procedures in order to minimize exposure to EMF fields from the welding circuit:

2.d.1. Route the electrode and work cables together - Secure them with tape when possible.

2.d.2. Never coil the electrode lead around your body.

2.d.3. Do not place your body between the electrode and work cables. If the electrode cable is on your right side, the work cable should also be on your right side.

2.d.4. Connect the work cable to the workpiece as close as possible to the area being welded.

2.d.5. Do not work next to welding power source.

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ELECTRIC SHOCK can kill.

3.a. The electrode and work (or ground) circuits are electrically "hot" when the welder is on. Do not touch these "hot" parts with your bare skin or wet clothing. Wear dry, hole-free gloves to insulate hands.

3.b. Insulate yourself from work and ground using dry insulation. Make certain the insulation is large enough to cover your full area of physical contact with work and ground.

In addition to the normal safety precautions, if welding must be performed under electrically hazardous conditions (in damp locations or while wearing wet clothing; on metal structures such as floors, gratings or scaffolds; when in cramped positions such as sitting, kneeling or lying, if there is a high risk of unavoidable or accidental contact with the workpiece or ground) use the following equipment:

- **Semiautomatic DC Constant Voltage (Wire) Welder.**
- **DC Manual (Stick) Welder.**
- **AC Welder with Reduced Voltage Control.**

3.c. In semiautomatic or automatic wire welding, the electrode, electrode reel, welding head, nozzle or semiautomatic welding gun are also electrically "hot".

3.d. Always be sure the work cable makes a good electrical connection with the metal being welded. The connection should be as close as possible to the area being welded.

3.e. Ground the work or metal to be welded to a good electrical (earth) ground.

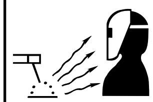
3.f. Maintain the electrode holder, work clamp, welding cable and welding machine in good, safe operating condition. Replace damaged insulation.

3.g. Never dip the electrode in water for cooling.

3.h. Never simultaneously touch electrically "hot" parts of electrode holders connected to two welders because voltage between the two can be the total of the open circuit voltage of both welders.

3.i. When working above floor level, use a safety belt to protect yourself from a fall should you get a shock.

3.j. Also see Items 6.c. and 8.

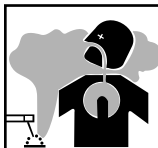


ARC RAYS can burn.

4.a. Use a shield with the proper filter and cover plates to protect your eyes from sparks and the rays of the arc when welding or observing open arc welding. Headshield and filter lens should conform to ANSI Z87. I standards.

4.b. Use suitable clothing made from durable flame-resistant material to protect your skin and that of your helpers from the arc rays.

4.c. Protect other nearby personnel with suitable, non-flammable screening and/or warn them not to watch the arc nor expose themselves to the arc rays or to hot spatter or metal.



FUMES AND GASES can be dangerous.

5.a. Welding may produce fumes and gases hazardous to health. Avoid breathing these fumes and gases.When welding, keep your head out of the fume. Use enough ventilation and/or exhaust at the arc to keep fumes and gases away from the breathing zone. **When welding with electrodes which require special ventilation such as stainless or hard facing (see instructions on container or MSDS) or on lead or cadmium plated steel and other metals or coatings which produce highly toxic fumes, keep exposure as low as possible and below Threshold Limit Values (TLV) using local exhaust or mechanical ventilation. In confined spaces or in some circumstances, outdoors, a respirator may be required. Additional precautions are also required when welding on galvanized steel.**

5.b. Do not weld in locations near chlorinated hydrocarbon vapors coming from degreasing, cleaning or spraying operations. The heat and rays of the arc can react with solvent vapors to form phosgene, a highly toxic gas, and other irritating products.

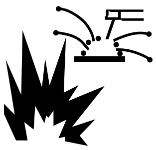
5.c. Shielding gases used for arc welding can displace air and cause injury or death. Always use enough ventilation, especially in confined areas, to insure breathing air is safe.

5.d. Read and understand the manufacturer's instructions for this equipment and the consumables to be used, including the material safety data sheet (MSDS) and follow your employer's safety practices. MSDS forms are available from your welding distributor or from the manufacturer.

5.e. Also see item 1.b.

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WELDING SPARKS can cause fire or explosion.

6.a. Remove fire hazards from the welding area. If this is not possible, cover them to prevent the welding sparks from starting a fire. Remember that welding sparks and hot materials from welding can easily go through small cracks and openings to adjacent areas. Avoid welding near hydraulic lines. Have a fire extinguisher readily available.

6.b. Where compressed gases are to be used at the job site, special precautions should be used to prevent hazardous situations. Refer to “Safety in Welding and Cutting” (ANSI Standard Z49.1) and the operating information for the equipment being used.

6.c. When not welding, make certain no part of the electrode circuit is touching the work or ground. Accidental contact can cause overheating and create a fire hazard.

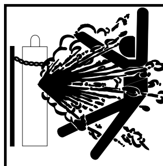
6.d. Do not heat, cut or weld tanks, drums or containers until the proper steps have been taken to insure that such procedures will not cause flammable or toxic vapors from substances inside. They can cause an explosion even though they have been “cleaned”. For information, purchase “Recommended Safe Practices for the Preparation for Welding and Cutting of Containers and Piping That Have Held Hazardous Substances”, AWS F4.1 from the American Welding Society (see address above).

6.e. Vent hollow castings or containers before heating, cutting or welding. They may explode.

6.f. Sparks and spatter are thrown from the welding arc. Wear oil free protective garments such as leather gloves, heavy shirt, cuffless trousers, high shoes and a cap over your hair. Wear ear plugs when welding out of position or in confined places. Always wear safety glasses with side shields when in a welding area.

6.g. Connect the work cable to the work as close to the welding area as practical. Work cables connected to the building framework or other locations away from the welding area increase the possibility of the welding current passing through lifting chains, crane cables or other alternate circuits. This can create fire hazards or overheat lifting chains or cables until they fail.

6.h. Also see item 1.c.



CYLINDER may explode if damaged.

7.a. Use only compressed gas cylinders containing the correct shielding gas for the process used and properly operating regulators designed for the gas and pressure used. All hoses, fittings, etc. should be suitable for the application and maintained in good condition.

7.b. Always keep cylinders in an upright position securely chained to an undercarriage or fixed support.

7.c. Cylinders should be located:
- Away from areas where they may be struck or subjected to physical damage.
- A safe distance from arc welding or cutting operations and any other source of heat, sparks, or flame.

7.d. Never allow the electrode, electrode holder or any other electrically “hot” parts to touch a cylinder.

7.e. Keep your head and face away from the cylinder valve outlet when opening the cylinder valve.

7.f. Valve protection caps should always be in place and hand tight except when the cylinder is in use or connected for use.

7.g. Read and follow the instructions on compressed gas cylinders, associated equipment, and CGA publication P-l, “Precautions for Safe Handling of Compressed Gases in Cylinders,” available from the Compressed Gas Association 1235 Jefferson Davis Highway, Arlington, VA 22202.



FOR ELECTRICALLY powered equipment.

8.a. Turn off input power using the disconnect switch at the fuse box before working on the equipment.

8.b. Install equipment in accordance with the U.S. National Electrical Code, all local codes and the manufacturer’s recommendations.

8.c. Ground the equipment in accordance with the U.S. National Electrical Code and the manufacturer’s recommendations.

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PRÉCAUTIONS DE SÛRETÉ

Pour votre propre protection lire et observer toutes les instructions et les précautions de sûreté specifiques qui parraissent dans ce manuel aussi bien que les précautions de sûreté générales suivantes:

Sûreté Pour Soudage A L'Arc

1. Protegez-vous contre la secousse électrique:

   a. Les circuits à l'électrode et à la piéce sont sous tension quand la machine à souder est en marche. Eviter toujours tout contact entre les parties sous tension et la peau nue ou les vétements mouillés. Porter des gants secs et sans trous pour isoler les mains.
   b. Faire trés attention de bien s'isoler de la masse quand on soude dans des endroits humides, ou sur un plancher metallique ou des grilles metalliques, principalement dans les positions assis ou couché pour lesquelles une grande partie du corps peut être en contact avec la masse.
   c. Maintenir le porte-électrode, la pince de masse, le câble de soudage et la machine à souder en bon et sûr état defonctionnement.
   d. Ne jamais plonger le porte-électrode dans l'eau pour le refroidir.
   e. Ne jamais toucher simultanément les parties sous tension des porte-électrodes connectés à deux machines à souder parce que la tension entre les deux pinces peut être le total de la tension à vide des deux machines.
   f. Si on utilise la machine à souder comme une source de courant pour soudage semi-automatique, ces precautions pour le porte-électrode s'applicuent aussi au pistolet de soudage.

2. Dans le cas de travail au dessus du niveau du sol, se protéger contre les chutes dans le cas ou on recoit un choc. Ne jamais enrouler le câble-électrode autour de n'importe quelle partie du corps.

3. Un coup d'arc peut être plus sévère qu'un coup de soliel, donc:

   a. Utiliser un bon masque avec un verre filtrant approprié ainsi qu'un verre blanc afin de se protéger les yeux du rayonnement de l'arc et des projections quand on soude ou quand on regarde l'arc.
   b. Porter des vêtements convenables afin de protéger la peau de soudeur et des aides contre le rayonnement de l'arc.
   c. Protéger l'autre personnel travaillant à proximité au soudage à l'aide d'écrans appropriés et non-inflammables.

4. Des gouttes de laitier en fusion sont émises de l'arc de soudage. Se protéger avec des vêtements de protection libres de l'huile, tels que les gants en cuir, chemise épaisse, pantalons sans revers, et chaussures montantes.

5. Toujours porter des lunettes de sécurité dans la zone de soudage. Utiliser des lunettes avec écrans lateraux dans les zones où l'on pique le laitier.

6. Eloigner les matériaux inflammables ou les recouvrir afin de prévenir tout risque d'incendie dû aux étincelles.

7. Quand on ne soude pas, poser la pince à une endroit isolé de la masse. Un court-circuit accidental peut provoquer un échauffement et un risque d'incendie.

8. S'assurer que la masse est connectée le plus prés possible de la zone de travail qu'il est pratique de le faire. Si on place la masse sur la charpente de la construction ou d'autres endroits éloignés de la zone de travail, on augmente le risque de voir passer le courant de soudage par les chaines de levage, câbles de grue, ou autres circuits. Cela peut provoquer des risques d'incendie ou d'echauffement des chaines et des câbles jusqu'à ce qu'ils se rompent.

9. Assurer une ventilation suffisante dans la zone de soudage. Ceci est particuliérement important pour le soudage de tôles galvanisées plombées, ou cadmiées ou tout autre métal qui produit des fumeés toxiques.

10. Ne pas souder en présence de vapeurs de chlore provenant d'opérations de dégraissage, nettoyage ou pistolage. La chaleur ou les rayons de l'arc peuvent réagir avec les vapeurs du solvant pour produire du phosgéne (gas fortement toxique) ou autres produits irritants.

11. Pour obtenir de plus amples renseignements sur la sûreté, voir le code "Code for safety in welding and cutting" CSA Standard W 117.2-1974.

PRÉCAUTIONS DE SÛRETÉ POUR LES MACHINES À SOUDER À TRANSFORMATEUR ET À REDRESSEUR

1. Relier à la terre le chassis du poste conformement au code de l'électricité et aux recommendations du fabricant. Le dispositif de montage ou la piece à souder doit être branché à une bonne mise à la terre.

2. Autant que possible, l'installation et l'entretien du poste seront effectués par un électricien qualifié.

3. Avant de faires des travaux à l'interieur de poste, la debrancher à l'interrupteur à la boite de fusibles.

4. Garder tous les couvercles et dispositifs de sûreté à leur place.

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Installation

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TECHNICAL SPECIFICATIONS - POWER WAVE 450

INPUT -THREE PHASE ONLY

Input Voltages:	200	230	400	460	575
Input Currents					
@ 500A/40 VDC	87	76	44	38	32
@ 450A/38 VDC	75	65	38	32	28

RATED OUTPUT

Duty Cycle	Amps	Volts at Rated Amperes
60% Duty Cycle	500	40 VDC
100% Duty Cycle	450	38 VDC

Constant Open Circuit Voltage	Continuous Current Range	Process Current Ranges
75 Volts	5-540 Amps	GMAW 50-540 Amps FCAW 40-540 Amps STICK 30-540 Amps

Pulse Current Range	Pulse Voltage Range	Pulse and Background Time Range	Pulse Frequency
5-750 Amps	5-55 Volts	100 Microsec - 3.3 Sec	0.15 - 1000 Hz

RECOMMENDED INPUT WIRE AND FUSE SIZES

Input Voltage/ Freqency	Duty Cycle	Input Ampere Rating on Nameplate	Type 75°C Copper Wire in Conduit AWG[IEC] Sizes (MM²)	Type 75°C Ground Wire in Conduit AWG[IEC] Sizes (MM²)	Type 75°C (Super Lag) or Breaker Size (Amps)
200/50-60	60%	87	4 (25)	8 (10)	120
230/50-60	60%	76	4 (25)	8 (10)	100
400/50-60	60%	44	8 (10)	10 (6)	50
460/50-60	60%	38	8 (10)	10 (6)	50
575/50-60	60%	32	8 (10)	10 (6)	50
200/50-60	100%	75	4 (25)	8 (10)	100
230/50-60	100%	65	4 (25)	8 (10)	100
400/50-60	100%	38	8 (10)	10 (6)	50
460/50-60	100%	32	8 (10)	10 (6)	50
575/50-60	100%	28	8 (10)	10 (6)	40

PHYSICAL DIMENSION

Height	Width	Depth	Weight
905 mm	515 mm	1010 mm	137.9 kg
35.6 in.	20.3 in.	39.8 in.	303.5 lbs.

OPERATING TEMPERATURE RANGE	STORAGE TEMPERATURE RANGE
0° to 40°C	-50° to 85°C

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Read this entire installation section before you start installation.

SAFETY PRECAUTIONS

WARNING



ELECTRIC SHOCK can kill.

- Only qualified personnel should perform this installation.
- Turn the input power OFF at the disconnect switch or fuse box before working on this equipment.

- Do not touch electrically hot parts.
- Always connect the Power Wave grounding terminal (located inside the reconnect input access doors).

SELECT SUITABLE LOCATION

Place the welder where clean cooling air can circulate in through the rear louvers and out through the side and front louvers. Dirt, dust, or any foreign material that can be drawn into the welder should be kept at a minimum. Using filters on the air intake to prevent dirt from building up restricts air flow. Do not use such filters. Failure to observe these precautions can result in excessive operating temperatures and nuisance shutdowns.

The Power Wave may be used outdoors. Power Wave power sources carry an IP23 enclosure rating. They are rated for use in damp, dirty environments subject to occasional falling water such as rain. However, the best practice is to keep the machine in a dry, sheltered area, since a wet environment speeds corrosion of parts. Do not place the machine in puddles or otherwise submerge parts of the machine in water. This may cause improper operation and is a possible safety hazard.

STACKING

Power Wave machines cannot be stacked.

TILTING

Each machine must be placed on a secure, level surface. The machine may topple over if this procedure is not followed.

LIFTING

Lift the machine by the lift bail only. Do not attempt to lift the machine by the push handle.

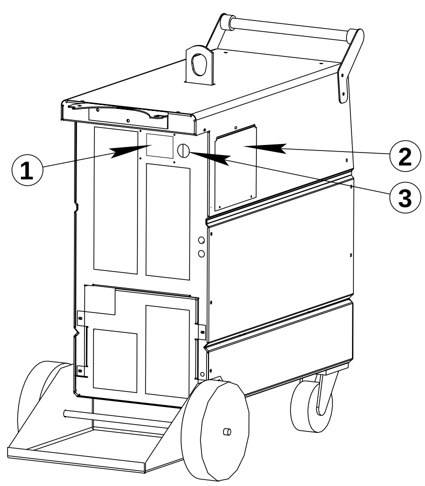
HIGH FREQUENCY PRECAUTIONS

If possible, locate the Power Wave away from radio controlled machinery. The normal operation of the Power Wave may adversely affect the operation of RF controlled equipment, which may result in bodily injury or damage to the equipment.

INPUT CONNECTIONS

Be sure the voltage, phase, and frequency of the input power is as specified on the rating plate, located on the rear of the machine. See Figure A.1 for the location of the rating plate.

FIGURE A.1 - RATING PLATE LOCATION



1. RATING PLATE
2. RECONNECT/INPUT ACCESS DOOR
3. INPUT CORD ACCESS HOLE

WARNING

Only a qualified electrician should connect the input leads to the Power Wave. Connections should be made in accordance with all local and national electrical codes and the connection diagram located on the inside of the reconnect/input access door of the machine. Failure to do so may result in bodily injury or death.

Use a three-phase supply line. The Power Wave has a 1.375" (35mm) access hole for the input cord, but the input cord is not supplied.

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⚠ CAUTION

Failure to follow these instructions can cause immediate failure of components within the welder.

GROUND CONNECTIONS

The frame of the welder must be grounded. A ground terminal marked with the symbol is located inside the reconnect/input access door for this purpose. See your local and national electrical codes for proper grounding methods. See Figure A.2 for the location of the reconnect/input access door and related connection diagram.

INPUT POWER CONNECTIONS

Connect L1, L2, L3 according to the Input Supply Connection Diagram decal located on the reconnect/-input access door. See Figure A.2.

INPUT FUSE AND SUPPLY WIRE CONSIDERATIONS

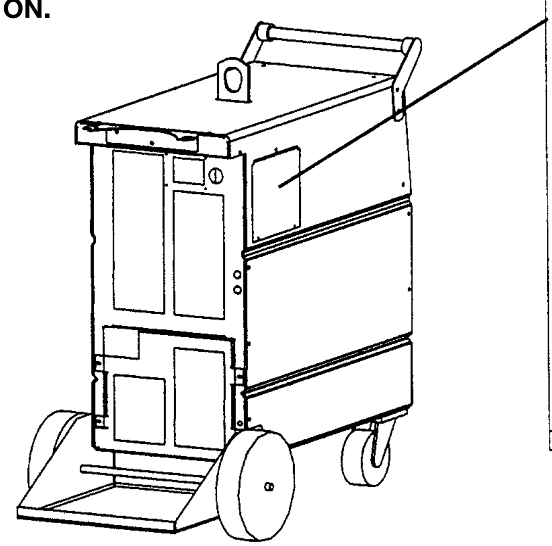
Refer to the Technical Specifications at the beginning of this Installation section for recommended fuse and wire sizes. Fuse the input circuit with the recommended super lag fuses or delay type circuit breakers. Choose an input and grounding wire size according to local or national electrical codes. Using fuses or circuit breakers smaller than recommended may result in "nuisance" shut-offs from welder inrush currents, even if the machine is not being used at high currents.

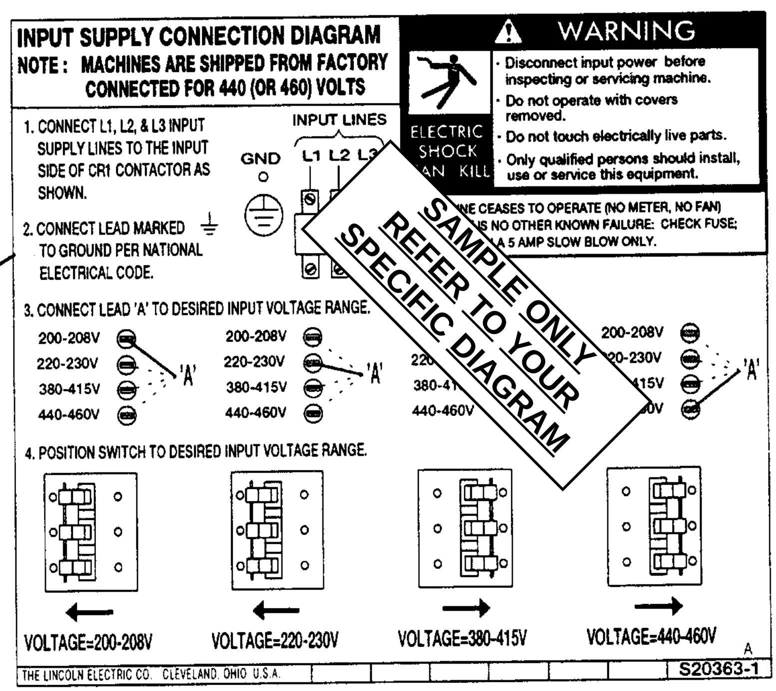
INPUT VOLTAGE RECONNECT PROCEDURE

Welders are shipped connected for the highest input voltage listed on the rating plate. To change this connection for a different input voltage, refer to reconnect instructions in Figure A.2 and proceed according to the steps that follow for the appropriate voltage.

FIGURE A.2 - CONNECTION DIAGRAM ON RECONNECT/INPUT ACCESS DOOR

NOTE: Turn main input power to mthe machine OFF before performing reconnect procedure. Failure to do so will result in damage to the machine. DO NOT switch the reconnect bar with machine power ON.

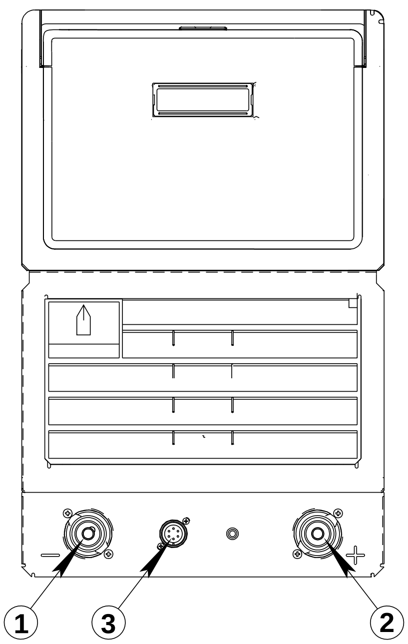


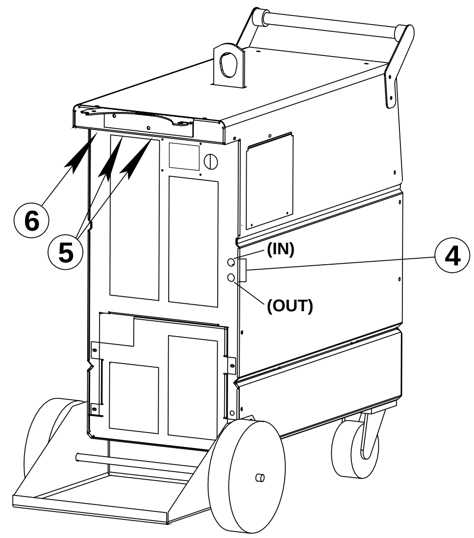


Also called "inverse time" or "thermal/magnetic" circuit breakers. These breakers have a delay in tripping action that decreases as the magnitude of the current increases.

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FIGURE A.3 – FRONTPANEL/BACK PANEL





1 WORK TERMINAL
2 ELECTRODE TERMINAL
3 REMOTE CONTROL AMPHENOL RECEPTACLE

4 WATER COOLING FITTINGS (ON BACK PANEL)
5 WIRE FEEDER CONNECTIONS (ON BACK PANEL)
6 ELECTRODE TERMINAL

To operate at 200-208 VAC:

1. Open the reconnect/input access door.
2. Move the input voltage switch to Voltage = 200-208V position.
3. Move "A" lead to the 200-208V terminal.

To operate at 220-230 VAC:

1. Open the reconnect/input access door.
2. Move the input voltage switch to voltage = 220-230V position.
3. Move "A" lead to the 220-230V terminal.

To operate at 380-415 VAC:

1. Open the reconnect/input access door.
2. Move the input voltage switch to Voltage = 380-415V position.
3. Move "A" lead to the 380-415 VAC terminal.

To operate at 440-460 VAC: No setup required. The machine is factory-connected to operate at 440 volts. To verify, do the following:

1. Open the reconnect/input access door.
2. Check that the input voltage switch is set to Voltage = 440-460V position.
3. Check that the "A" lead is at the 440-460V.

OUTPUT CONNECTIONS

See Figure A.3 for the location of the work terminal, electrode terminal, remote control amphenol receptacle, water cooler fittings and wire feeder connections.

WORK AND ELECTRODE CABLE CONNECTIONS

SIZE

Use the largest welding (electrode and ground) cables possible — at least $70mm^2$ (#2/0) copper wire — even if the output current does not require it. When pulsing, the pulse current often exceeds 650 amps with the Power Wave 450. Voltage drops can become excessive if undersized welding cables are used.

ROUTING

To avoid interference problems with other equipment and to achieve the best possible operation, route all cables directly. Avoid excessive lengths, bundle the electrode and ground cables together where practical, and do not coil excess cable.

WATER COOLER CONNECTIONS

The water cooler fittings are a quick-connect type. Refer to the Accessories section of this manual for water cooler operation and antifreeze mixtures.

WIRE FEEDER CONNECTIONS

Refer to the ***Accessories*** section for Wire Feeder Connections.

Refer to Setup overlay in ***Operation*** section for Wire Feeder Configuration.

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OPERATING INSTRUCTIONS

Read and understand this entire section of operating instructions before operating the machine.

SAFETY INSTRUCTIONS

⚠ WARNING



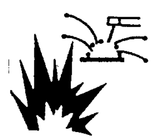
ELECTRIC SHOCK can kill.

- Do not touch electrically live parts or electrodes with your skin or wet clothing.
- Insulate yourself from the work and ground.
- Always wear dry insulating gloves.



FUMES AND GASES can be dangerous.

- Keep your head out of fumes.
- Use ventilation or exhaust to remove fumes from breathing zone.



WELDING SPARKS can cause fire or explosion.

- Keep flammable material away.
- Do not weld on containers that have held combustibles.



ARC RAYS can burn.

- Wear eye, ear, and body protection.

Observe additional Safety Guidelines detailed in the beginning of this manual.



HOT COOLANT can burn skin.

- Always be sure coolant is not hot before doing any work on cooler parts.

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QUICK START REFERENCE FOR USING THE PROCESS SELECTION OVERLAY

Read and understand the "Controls and Settings" and "Operating Overlays" sections of this manual before using the following Quick Start Reference procedure to operate the Power Wave.

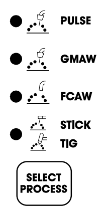
NOTE: Selection of certain options may limit the selection of subsequent options.

Step 1: Select your process information:

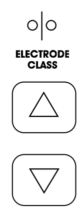
a. Install the desired PROCESS OVERLAY.

b. Turn the machine ON.

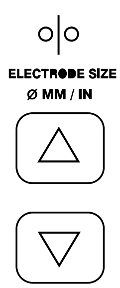
c. Select the desired welding PROCESS[1].



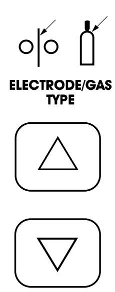
d. Select ELECTRODE CLASS.



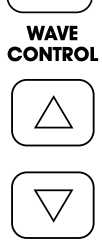
e. Select ELECTRODE SIZE.



f. Select ELECTRODE/GAS TYPE.



g. Press the WAVE CONTROL UP or DOWN keys to see the present setting. Press the WAVE CONTROL UP or WAVE CONTROL DOWN keys to adjust[2].



Step 2: Adjust the wire feed to speed "WFS" and voltage "V" or arc length "T" (if necessary).

a. Press the DISPLAY RECALL key [DISPLAY RECALL] to view additional procedure information.

b. Adjust wire feed speed and voltage or arc length trim through the controls on your wire feeder. The new values appear on both the wire feeder and the Power Wave display.

Step 3: Save process information (if desired).

a. Press the SAVE TO MEMORY key [SAVE] .

b. Press one of the MEMORY LOCATION keys (1-8).

You can recall your procedure later by pressing the RECALL FROM MEMORY key [RECALL] and the appropriate MEMORY LOCATION key.

[1] The electrode class, electrode size, and electrode/gas type you can select for your process will be limited to the machine's programmed recommendations. Therefore, selecting certain options may limit other option selections.

[2] The wave control scale displayed shows the default setting. (The higher the setting, the softer the arc.) If you change the setting, your new setting will be displayed.

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GENERAL DESCRIPTION

The INVERTEC Power Wave power source is a high performance, digitally controlled inverter welding power source capable of complex, high-speed waveform control. It uses three-phase input power only. The Power Wave is designed to be used as a synergic welding system in conjunction with a wire feeder.

SYNERGIC WELDING

The Power Wave system is designed primarily as a synergic welding system. The word "synergic" comes from the word "synergism," which means "two or more things working together to achieve an effect which neither can achieve individually."

The Power Wave and wire feeder operate as a team. Each "knows" what the other is doing at all times. They each also know what process, wire type, wire size, and gas combination are being used. In a synergic system, the wire feeder and power source must "talk" together. This means that only certain wire feeders can work in a synergic setup. A synergic feeder has special circuitry to "talk" with and "listen" to the Power Wave power source.

Welding experts have preprogrammed the system for the best range of process settings according to wire type, wire size, and gas combination. When the wire feed speed is changed, the system automatically adjusts the current and voltage waveforms to give the best weld characteristics. This improves the soundness, appearance, and repeatability of welds.

Refer to the ***Accessories*** section of this manual for available wire feeders.

RECOMMENDED PROCESSES

The Power Wave is designed to be used as a multiple process machine. It comes preprogrammed with GMAW pulse, GMAW (short arc and spray) FCAW (Innershield™ and Outershield™), and stick procedures.

OPERATIONAL FEATURES AND CONTROLS

The Power Wave, through use of a keypad overlay system, provides various options and controls such as Multiple Process/Procedure Selection; Memory Storage of Procedures; Weld from Memory Only operation; Dual Process/Dual Feeder capability.

DESIGN FEATURES AND ADVANTAGES

- Designed to NEMA Standards.
- Multiple process output ranges 5 - 540 amps.
- 2-line LCD display.
- Easy access for input connections. Connections are simple strip and clamp (no lugs required).
- Modular construction for easy servicing.
- Thermostatically protected.
- Electronic overcurrent protection.
- Overvoltage protection.
- Digital signal processor and microprocessor control.
- RS232 interface for future welding application updates.
- Simple, reliable reconnection for various input voltages.
- New accessories and wire feeders communicate using a digital current loop to transfer information.
- Auto device recognition simplifies accessory cable connections.
- Direct support of two wire feeders.
- Auto-configurable for either metric or English mode.
- Multi-process control: Stick, short arc, GMAW spray, GMAW pulse, and flux cored arc welding (FCAW).
- Simple control through use of overlays that limit access to only those keys required for a given application.

WELDING CAPABILITY

The Power Wave 450 is rated at 500 amps, 40 volts at 60% duty cycle based on a ten minute time period. It is capable of higher duty cycles at lower output currents. If the duty cycles are exceeded, a thermostat will shut off the output until the machine cools to a reasonable operating temperature.

LIMITATIONS

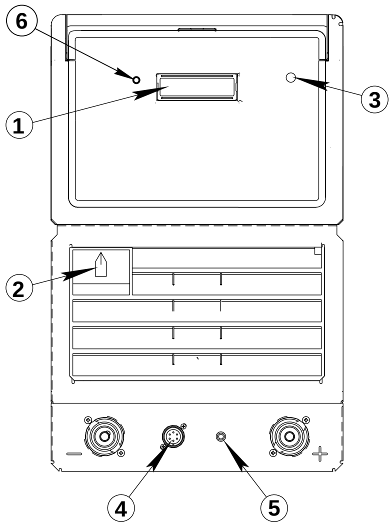
- The Power Wave is not recommended for processes other than those specified by available overlays.
- The Power Wave is not recommended for pipe thawing.

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CONTROLS AND SETTINGS

All operator controls and adjustments are located on the case front of the Power Wave. Refer to Figure B.1 and corresponding explanations.

FIGURE B.1 – CASE FRONT CONTROLS



1 LCD DISPLAY
2 POWER SWITCH
3 HIGH TEMPERATURE LIGHT
4 REMOTE CONTROL AMPHENOL RECEPTACLE
5 5 AMP CIRCUIT BREAKER
6 LCD DISPLAY ADJUSTMENT

CASE FRONT CONTROLS

Refer to Figure B.1 for the location of the following controls:

1. LCD DISPLAY: Provides welding procedure information and parameters such as wire type, gas type, WFS, trim, etc.
2. POWER SWITCH: Controls input power to the Power Wave. When the switch is turned to the ON position, the connected wire feeder meters light up and the LCD display on the Power Wave shows the following:

   LINCOLN ELECTRIC
   Version X.X

   This display is shown for a few seconds followed by another display that depends on the overlay placed on the machine. At this point, the machine is ready for operation.
3. HIGH TEMPERATURE LIGHT (thermal overload): A yellow light that comes on when an over temperature situation occurs. Output is disabled until the machine cools down. At that point the light goes out and output is enabled again.
4. REMOTE CONTROL AMPHENOL RECEPTACLE: Allows remote current control during stick welding via a hand or foot Amptrol accessory.
5. 5 AMP CIRCUIT BREAKER: Protects two auxiliary power circuits: the 24V supply used by the trigger circuits and the 42V supply used by the internal machine circuits and the wire feeders.
6. LCD DISPLAY ADJUSTMENT: Use a small flat blade screw driver to adjust the viewing angle of the LCD display.

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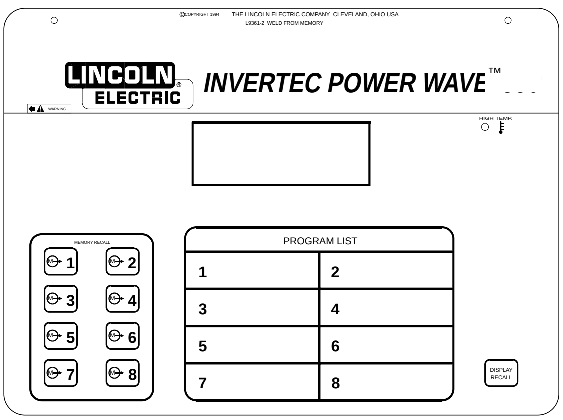
OPERATING OVERLAYS

OVERVIEW

The Power Wave is controlled by a panel of keys (keypad) located on the front of the machine. The operator can access controls by placing an overlay over the keys.

An OVERLAY is a special plastic sheet with a number of keys and symbols printed on one side and a bar code printed on the other. See Figure B.2. The printed keys allow the operator to communicate with the machine for a specific set of functions. The bar code allows the machine to identify the overlay.

FIGURE B.2 – TYPICAL POWER WAVE OVERLAY

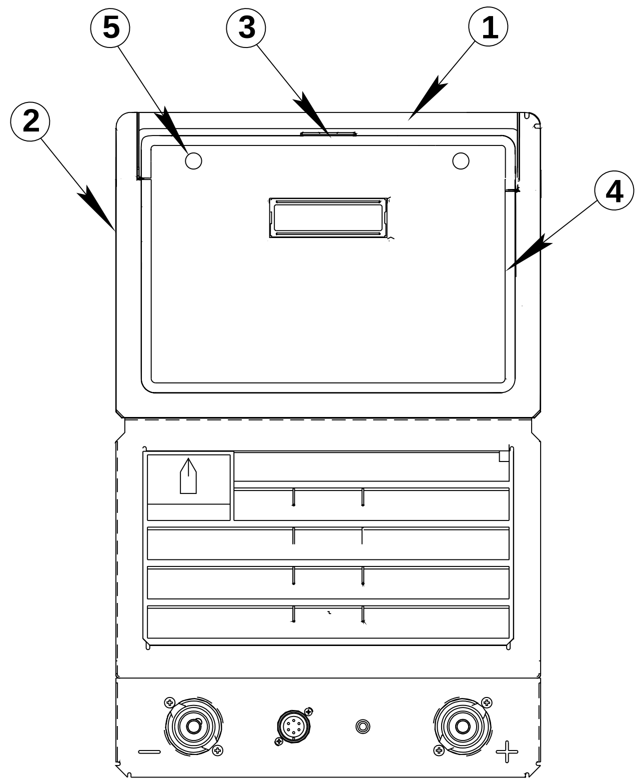


Before the Power Wave is turned ON, the operator selects the desired overlay and mounts it in the overlay frame on the front of the machine. Then, when the machine is turned ON, it reads the overlay bar code and configures the machine accordingly, allowing the operator to access only certain keys. **The machine must be powered up each time an overlay is changed.**

INSTALLING AN OVERLAY

1. Open the ACCESS DOOR by grasping the provided indent on the door and pulling the door forward. See Figure B.3 for door location.

FIGURE B.3 – OVERLAY ACCESS DOOR



1 OVERLAY ACCESS DOOR
2 OVERLAY FRAME
3 ACCESS DOOR INDENT
4 TRACKS
5 LOCATING PINS

2. Select the desired overlay from the storage compartment located behind the access door.
3. Remove any overlay already in the overlay frame and place it in the storage compartment.
4. Slide the new overlay into the overlay frame. Align the overlay with the two tracks on the sides of the frame. Be sure the overlay is seated in the bottom lip of the frame and on the top two locating pins. Close the access door securely.

OVERLAY TYPES

Four types of overlays can be used with the Power Wave.

1. **Process Overlays.** These overlays are used to create, save and recall specific welding procedures by selecting and adjusting the various welding settings that have been programmed into the Power Wave at the factory.
2. **Weld From Memory Overlays**. These overlays (also called Shop Overlays) provide a simple way for operators to recall and use any of the welding procedures that have been stored in the memory of the Power Wave.
3. **Setup Overlays**. These overlays provide specific machine setup information, such as operating limits for the welding procedures stored in memory.
4. **Special Purpose Overlays.** These are custom overlays for specific customer applications.

Detailed information on how to use currently available Power Wave overlays follows.

Overlay Type	Overlay Name	Figure No.
1	GMAW PULSE, GMAW FCAW, STICK PROCESS SELECTION OVERLAY	B.4
2	WELD FROM MEMORY OVERLAY	B.5
2	WELD FROM MEMORY, DUAL PROCEDURE OVERLAY	B.6
2	*DUAL WIRE FEEDERS, DUAL PROCEDURES OVERLAY	B.7
3	*LIMITS OVERLAY	B.8
3	SETUP OVERLAY	B.9

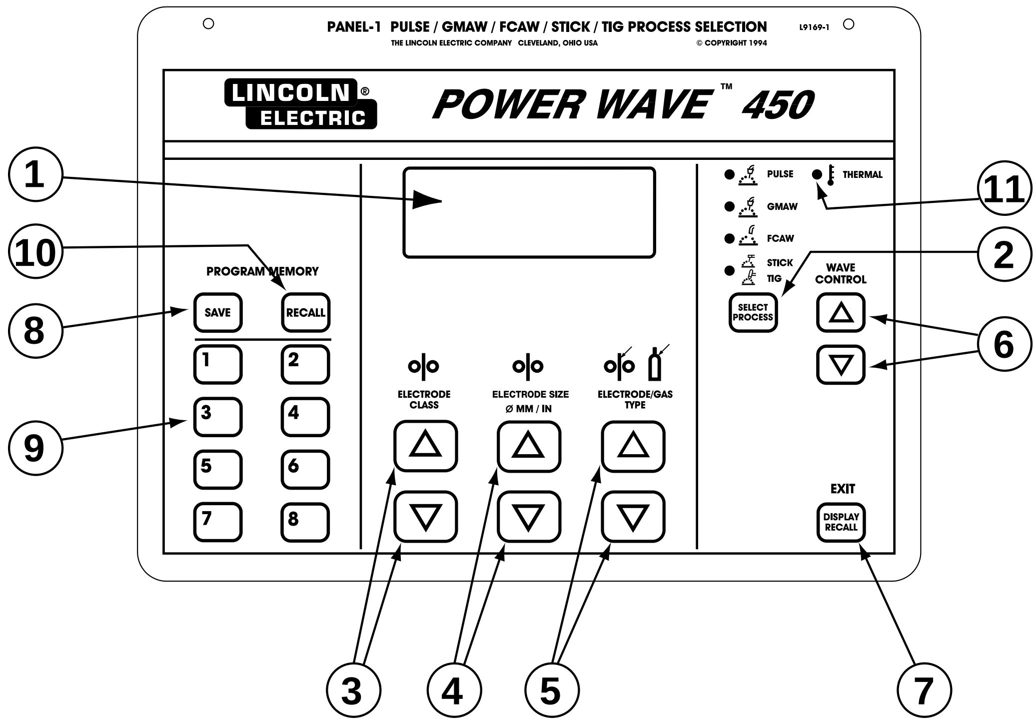
*These overlays are optional. See Accessories Section for Order Numbers.

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PULSE, GMAW, FCAW, AND STICK/TIG PROCESS SELECTION OVERLAY

An operator can use this overlay to create a new welding procedure, save a newly created welding procedure, view an existing welding procedure, recall an existing welding procedure, and clear a memory location. See Figure B.4. The steps for performing each of these functions are given below.

FIGURE B.4 – PULSE, GMAW, FCAW, STICK/TIG PROCESS SELECTION OVERLAY



1 LCD DISPLAY WINDOW
2 PROCESS SELECT KEY
3 ELECTRODE CLASS UP/DOWN KEYS
4 ELECTRODE SIZE UP/DOWN KEYS
5 ELECTRODE/GAS TYPE UP/DOWN KEYS
6 WAVE CONTROL UP/DOWN KEYS
7 DISPLAY RECALL KEY
8 SAVE TO MEMORY KEY
9 MEMORY LOCATION NUMBER KEYS
10 RECALL FROM MEMORY KEY
11 HIGH TEMPERATURE LIGHT

1. **LCD DISPLAY WINDOW**: Power up the machine with this overlay in place. When the Power Wave is turned on, the following message appears on the display for a few seconds:

LINCOLN ELECTRIC
VERSION X.X

This display is followed by:

OVERLAY ID
NUMBER = 1

A welding procedure is made up of seven components: process, material type, wire diameter, program, wire feed speed, voltage or arc length trim, and wave control. A new welding procedure is created by selecting a combination of these components from the ones that have been programmed into the Power Wave. See Figure B.4 for key locations.

NOTE: The following four selections should always be performed in this order: process, electrode class, electrode size, electrode/gas type. Selecting a setting for one component narrows your choice of available settings in remaining components. This is why the order of performing the steps is important. However, if you make component selections out of order, the machine will prompt you to make a new selection for any settings that do not apply.

2. **PROCESS SELECT KEY:** Use the PROCESS SELECT key to select from the processes available in the machine. Press the PROCESS SELECT key until the light by the desired process is lit.

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3. **ELECTRODE CLASS UP/DOWN:** Use the ELECTRODE CLASS UP or DOWN keys to select from the material types available for the selected process. Press the ELECTRODE CLASS UP or DOWN key until the desired material type is displayed.

4. **ELECTRODE SIZE UP/DOWN:** Use the ELECTRODE SIZE UP or DOWN keys to select from the wire diameters available for the selected process and material type. Press the ELECTRODE SIZE UP or DOWN key until the desired wire diameter is displayed.

5. **ELECTRODE/GAS TYPE UP/DOWN KEYS:** Use the ELECTRODE/GAS TYPE UP or DOWN keys to select from the programs available for the selected process, material type, and wire diameter. Press the ELECTRODE/GAS TYPE UP or DOWN Key until the desired program is displayed.

6. **WAVE CONTROL UP/DOWN KEYS:** Press one of the two WAVE CONTROL keys to display the present wave control. This is shown on a scale from LO to HI. Use the WAVE CONTROL UP or WAVE CONTROL DOWN key to change the wave control to the desired level. When this scale is shown, the WAVE CONTROL setting can also be changed while welding (on the fly). Press the DISPLAY RECALL key to exit the wave control function. For a description of how the wave control setting affects the welding procedure, refer to the Overview of Welding Procedures sub-section of the Operation section of this manual.

   The wire feed speed and voltage or arc length trim desired for the new procedure can be changed from the wire feeder.

7. **DISPLAY RECALL KEY:** Since not all the information about the procedure can be seen on the 2-line LCD display window at the same time, use the DISPLAY RECALL key to display and verify all of the selected procedure information. The normal default display window shows the Procedure Description, WFS, and preset voltage or arc length trim values. Press and hold the DISPLAY RECALL key, and the window shows the procedure description and gas type for as long as the key is held depressed. Release the DISPLAY RECALL key, and the window shows wire size, material type, and process description. After a few seconds, the window changes back to the default display.

8. **SAVE TO MEMORY KEY:** This key is used to save a newly created welding procedure. The Power Wave has eight memory locations which can be used to store all the settings of up to eight welding procedures. Once stored in a memory location, a procedure can be recalled for later use with the RECALL FROM MEMORY key. To save a newly created welding procedure:

   Press the SAVE TO MEMORY key (SAVE) and then one of the MEMORY LOCATION NUMBER keys. Keep a record of this number for future reference.

   Any previously created welding procedure stored in that location will be erased.

   If you press the SAVE TO MEMORY key but decide not to save the procedure, you can exit this function by pressing the DISPLAY RECALL key.

9. **MEMORY LOCATION NUMBER KEYS:** To view information about any stored welding procedure, simply press its MEMORY LOCATION NUMBER key.

   As you hold down the selected key, the procedure description and gas type of the procedure appear in the display window. The process type is shown by the indicating light opposite the appropriate process symbol.

   When you release the selected key, the wire size, material type and process description appear for a few seconds.

   This function does not display the wire feed speed and voltage or arc length trim settings. To view these, you must recall the procedure from memory with the RECALL FROM MEMORY key.

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10. **RECALL FROM MEMORY KEY:** This key is used to recall an existing procedure from memory. You can recall and use any of the previously created welding procedures that are stored in one of the eight memory locations. Simply press the RECALL FROM MEMORY key RECALL and then the appropriate MEMORY LOCATION NUMBER key.

    If you press the RECALL FROM MEMORY key and then change your mind, you can exit this function by pressing the DISPLAY RECALL key. If the memory location you select does not contain a stored welding procedure, this will be indicated in the display window. Select another memory location. It is not necessary to save a procedure back to memory after it is recalled from memory. When a procedure is saved into a memory location, it can be recalled from there until another procedure is stored in that location or the location is cleared.

    The RECALL FROM MEMORY and SAVE TO MEMORY keys can be used to clear a memory location.

    Press the SAVE TO MEMORY key SAVE and then the RECALL FROM MEMORY key RECALL . (Do not press both keys at the same time.) A message in the display window will ask you to press the MEMORY LOCATION NUMBER key of the memory location you want to clear.

    If you press the SAVE TO MEMORY and RECALL FROM MEMORY keys and then change your mind, you can exit this function by pressing the DISPLAY RECALL key.

11. **HIGH TEMPERATURE LIGHT:** The high temperature light comes on when the internal machine temperature exceeds the allowed limit. Output is disabled until the machine cools down and the high temperature light goes out.

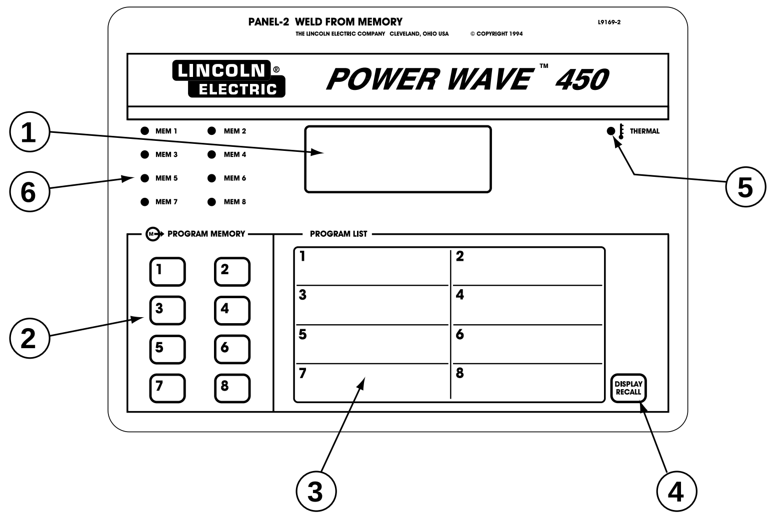
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WELD FROM MEMORY OVERLAY

The Weld From Memory Overlay lets an operator recall and use any welding procedure stored in one of eight memory locations. See Figure B.5.

FIGURE B.5 – WELD FROM MEMORY OVERLAY

1 LCD DISPLAY WINDOW
2 MEMORY RECALL KEYS
3 PROGRAM LIST
4 DISPLAY RECALL KEY
5 HIGH TEMPERATURE LIGHT
6 MEMORY LIGHTS



1. **LCD DISPLAY WINDOW:** Power up the machine with this overlay in place. When the Power Wave is turned on, the following message appears in the display window for a few seconds:

   LINCOLN ELECTRIC
   Version X.X

   This display is followed by:

   OVERLAY ID
   NUMBER = 2

   This message is then replaced by the following message:

   SELECT A MEMORY
   LOCATION

2. **MEMORY RECALL NUMBERS:** Select the memory location of the desired welding procedure by pressing the appropriate MEMORY RECALL NUMBER key.

   If no procedure was saved in the selected memory location, the following message appears:

   MEMORY LOCATION
   # IS EMPTY

   Select another memory location.

   When a welding procedure is recalled from memory, the display window will show the procedure description, wire feed speed, and arc length trim or preset voltage.

   With this overlay in place, the wire feed speed and the preset voltage or arc length trim can be changed from the wire feeder. The new values will replace the previous values and become a permanent part of the procedure.

   If limits have been set on the wire feed speed, voltage or arc length trim of the selected procedure, these limits will be active when this overlay is in place. They cannot be overridden from this overlay.

3. **PROGRAM LIST:** The PROGRAM LIST block in the center of this overlay provides a convenient place to record a brief description of each welding procedure stored in memory. A “Dry Erase” marker should be used for this purpose.

4. **DISPLAY RECALL KEY**: To view other information about the selected procedure, press the DISPLAY RECALL key. The display window will show the procedure description and gas type of the selected procedure for as long as the key is held depressed. When the key is released, material type, wire size, and process descriptions will be displayed for a few seconds.

5. **HIGH TEMPERATURE LIGHT:** The high temperature light comes on when the internal machine temperature exceeds the allowed limit. Output is disabled until the machine cools down and the high temperature light goes out.

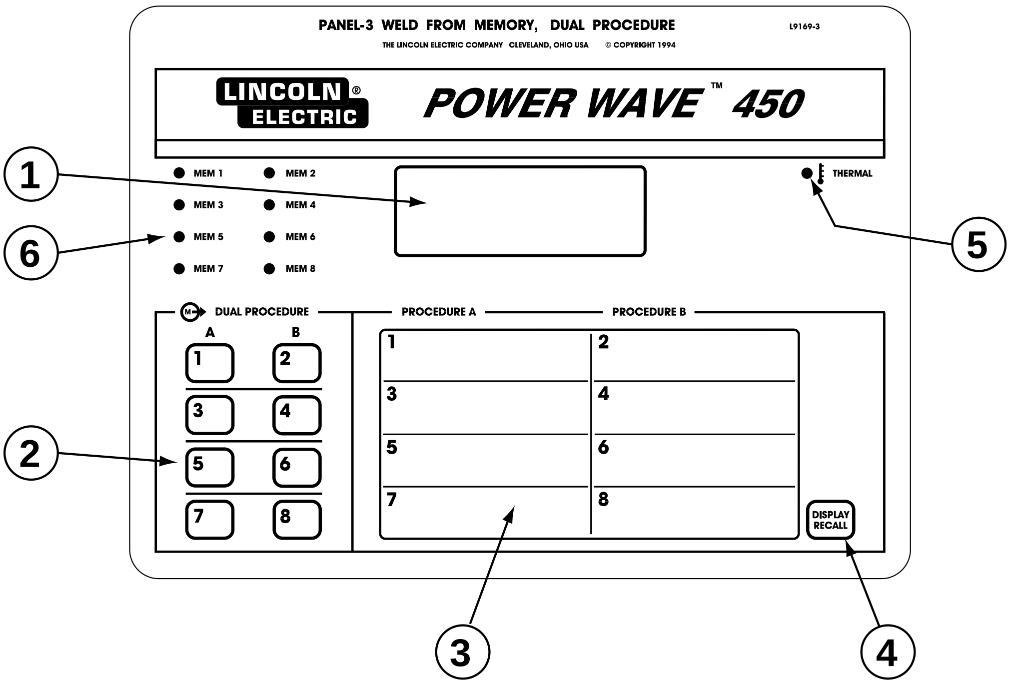
6. **MEMORY LIGHTS:** A memory light is on when its corresponding memory is selected. This tells you what memory is active at any given time.

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WELD FROM MEMORY, DUAL PROCEDURE OVERLAY

The Weld From Memory, Dual Procedure Overlay lets an operator recall and use dual welding procedures stored in memory. The overlay must be used with a separate dual procedure switch or a gun that has a two position trigger. The switch or trigger selects which procedure will be active. See Figure B.6

FIGURE B.6 – WELD FROM MEMORY, DUAL PROCEDURE OVERLAY



1 LCD DISPLAY WINDOW
2 MEMORY RECALL KEYS
3 PROGRAM LIST
4 DISPLAY RECALL KEY
5 HIGH TEMPERATURE LIGHT
6 MEMORY LIGHTS

1. **LCD DISPLAY WINDOW:** Power up the machine with this overlay in place. When the Power Wave is turned on, the following message appears in the display window for a few seconds:

   LINCOLN ELECTRIC
   Version X.X

   This display is followed by:

   OVERLAY ID
   NUMBER = 3

   This message is then replaced by the following message:

   SELECT A MEMORY
   LOCATION

2. **MEMORY RECALL KEYS:** The following four memory pairs are available on this overlay:
   Memory 1 and Memory 2
   Memory 3 and Memory 4
   Memory 5 and Memory 6
   Memory 7 and Memory 8

Select a memory location PAIR for the two desired welding procedures by pressing either of the two corresponding MEMORY RECALL NUMBER keys.

If no procedure was saved to one of the memory pair locations, the following message appears:

MEMORY LOCATION
IS EMPTY

In this case select another memory pair.

Set the dual procedure switch or gun trigger to the position for PROCEDURE A or PROCEDURE B. Position A activates the welding procedure from the odd numbered memory locations (1, 3, 5 or 7). Position B activates the welding procedure from the corresponding even numbered memory locations (2, 4, 6 or 8). **For example, if memory location 3 was selected, Position A activates the procedure from memory location 3; Position B activates the procedure from memory location 4.**

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When a pair of welding procedures are recalled from memory, the display window will show the procedure description, wire feed speed, and the preset voltage or arc length trim of the **LAST** procedure welded with.

With this overlay in place, the wire feed speed and the preset voltage or arc length trim can be changed from the wire feeder. The new values will replace the previous values and become a permanent part of the procedure.

If limits have been set on the wire feed speed, voltage or arc length trim of the selected procedures, these limits will be active when this overlay is in place. They cannot be overridden from this overlay.

3. **THE PROGRAM LIST:** The PROGRAM LIST block in the center of this overlay provides a convenient place to record a brief description of each welding procedure stored in memory. A “Dry Erase” marker should be used for this purpose.

4. **DISPLAY RECALL KEY:** To view other information about the active procedure, press the DISPLAY RECALL key. The display window will show the procedure description and gas type of the active procedure for as long as the key is held depressed. When the key is released, the wire size, material type, and process descriptions display for a few seconds.

5. **HIGH TEMPERATURE LIGHT:** The high temperature light comes on when the internal machine temperature exceeds the allowed limit. Output is disabled until the machine cools down and the high temperature light goes out.

6. **MEMORY LIGHTS**: A memory light is on when its corresponding memory is selected. This tells you what memory location is active at any given time.

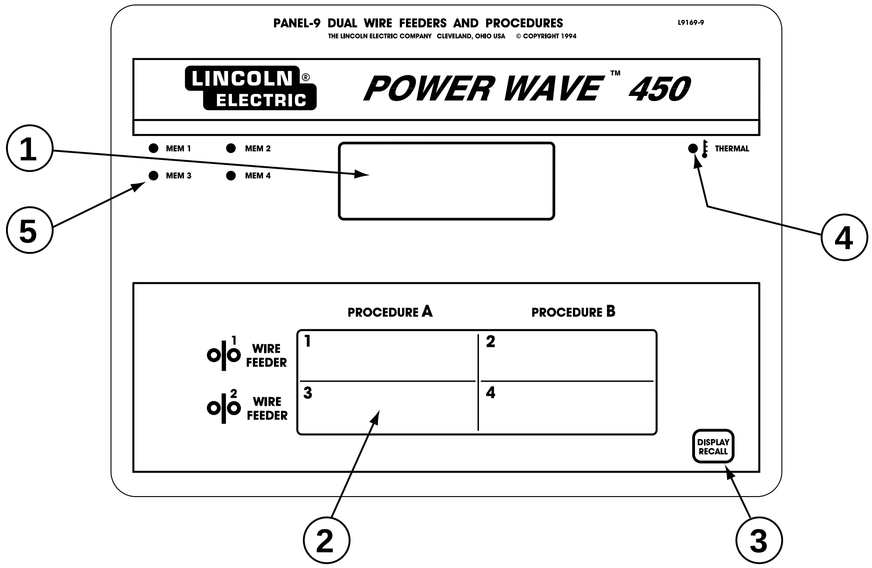
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DUAL WIRE FEEDERS, DUAL PROCEDURE OVERLAY (OPTIONAL)

The Dual Wire Feeders, Dual Procedures Overlay is used when the Power Wave is equipped with two wire feeders and two guns with two position switches. Any welding procedure stored in memory locations 1, 2, 3, or 4 can be automatically recalled and used. See Figure B.7.

FIGURE B.7 – DUAL WIRE FEEDERS, DUAL PROCEDURE OVERLAY

1 LCD DISPLAY WINDOW
2 WIRE FEEDERS MEMORY CHART
3 DISPLAY RECALL KEY
4 HIGH TEMPERATURE LIGHT
5 MEMORY LIGHTS



1. **LCD DISPLAY WINDOW:** Power up the machine with this overlay in place. When the Power Wave is turned on, the following message appears in the display window for a few seconds:

   LINCOLN ELECTRIC
   VERSION X.X

   This display is followed by:

   OVERLAY ID
   NUMBER = 9

2. **WIRE FEEDERS MEMORY CHART:** The active welding procedure is determined by the active wire feeder and its gun switch position. The welding procedure recall from memory is as follows:

Active Wire Feeder	Gun Trigger Position	Memory Location of Procedure
#1	A	1
#1	B	2
#2	A	3
#2	B	4

   Pull the trigger on either wire feeder.

   Depending on the gun switch position, the corresponding memory location is automatically recalled. The wire feeders memory chart has no keys; it is simply a chart.

   The display window will show the procedure description, wire feed speed, and the preset voltage or arc length trim of the last active welding procedure.

   With this overlay in place, the wire feed speed and the preset voltage or arc length trim can be changed from the wire feeder. The new values replace the previous values and become a permanent part of the procedure.

   If limits have been set on the wire feed speed, voltage or arc length trim of the selected procedures, these limits will be active when this overlay is in place. They cannot be overridden from this overlay.

3. **DISPLAY RECALL KEY:** To view other information about the active welding procedure, press the DISPLAY RECALL key. The display window will show the procedure description and gas type of the last active procedure for as long as the key is held depressed. When the key is released, the wire size, material type, and process descriptions will be displayed for a few seconds.

4. **HIGH TEMPERATURE LIGHT:** The high temperature light comes on when the internal machine temperature exceeds the allowed limit. Output is disabled until the machine cools down and the high temperature light goes out.

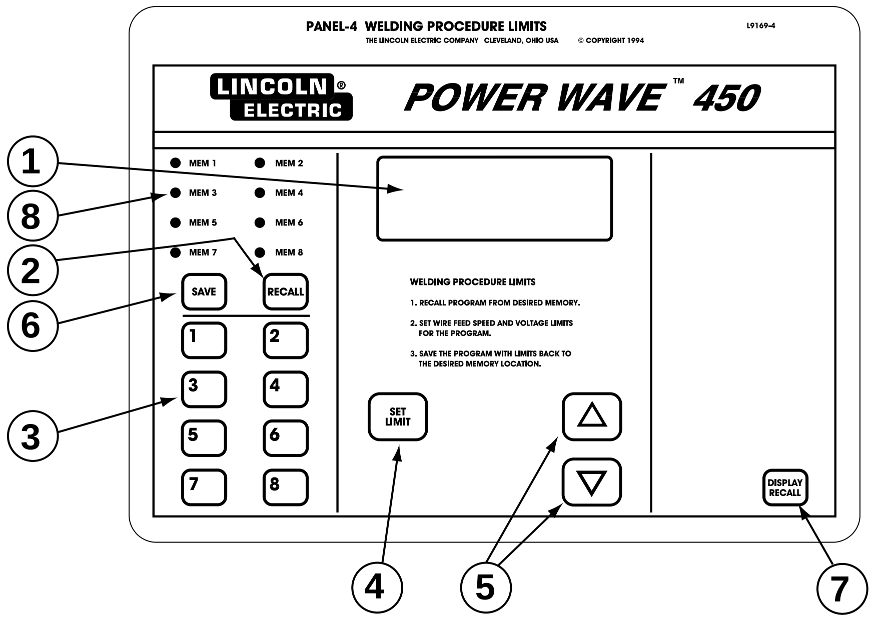
5. **MEMORY LIGHTS**: A memory light is on when its corresponding memory is selected. This tells you what memory location is active at any given time.

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LIMITS OVERLAY (OPTIONAL)

The Limits Overlay is used to set the maximum and minimum limits of the wire feed speed and voltage or arc length trim for any welding procedure stored in memory. See Figure B.8.

FIGURE B.8 – LIMITS OVERLAY



1 LCD DISPLAY WINDOW
2 RECALL FROM MEMORY KEY
3 MEMORY LOCATION NUMBER KEYS
4 SET LIMIT KEY
5 LIMIT UP/DOWN KEYS
6 SAVE TO MEMORY KEY
7 DISPLAY RECALL KEY
8 MEMORY LIGHTS

1. **LCD DISPLAY WINDOW:** Power up the machine with this overlay in place. When the Power Wave is turned on, the following message appears in the display window for a few seconds:

   LINCOLN ELECTRIC
   Version X.X

   This display is followed by:

   OVERLAY ID
   NUMBER = 4

   This message is then replaced by the following message:

   SELECT A MEMORY
   LOCATION

2. **RECALL FROM MEMORY KEY**:

   AND

3. **MEMORY LOCATION NUMBERS:**

   The RECALL FROM MEMORY key (RECALL) is used to recall a welding procedure from memory.

   Determine the memory location number of the welding procedure for which you want to set limits.Then press the RECALL FROM MEMORY key (RECALL) followed by the MEMORY LOCATION NUMBER key for the selected procedure.

   If no procedure was saved in the selected memory location, the following message appears:

   MEMORY LOCATION
   # IS EMPTY

   Select another memory location.

4. **SET LIMIT KEY:**

   AND

5. **LIMIT UP / DOWN KEYS:**

   The SET LIMIT key and LIMIT UP / LIMIT DOWN keys are used to set the maximum and minimum allowed wire feed speed, and voltage trim or arc length trim values of the procedure that was recalled from memory.

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Use the LIMIT UP and LIMIT DOWN keys to change the maximum wire feed speed to the desired value.

Press the SET LIMIT key again. The new maximum and old minimum wire feed speeds will be displayed.

Use the LIMIT UP and LIMIT DOWN keys to change the minimum wire feed speed to the desired value.

Press the SET LIMIT key. The present maximum and minimum voltage trim or arc length trim will be displayed. (Refer to ***Table B.3*** to see how voltage trim affects preset voltage. Refer to ***Table B.6*** to see how arc length trim affects preset arc length.)

Use the LIMIT UP and LIMIT DOWN keys to change the maximum value. The maximum for either type is 1.5.

Press the SET LIMIT key. The new maximum and old minimum voltage trim or arc length trim will be displayed.

Use the LIMIT UP and LIMIT DOWN keys to change the minimum value. The minimum for either type is 0.5.

6. **SAVE TO MEMORY KEY**: The SAVE TO MEMORY KEY is used to save the procedure with the newly set limits to memory. Press the SAVE TO MEMORY key (SAVE) followed by the MEMORY LOCATION NUMBER key of the desired memory location. This does not have to be the original location from which the procedure was recalled.

   Step 6 can be performed any time during the limit-setting process. You do not have to set all the available limits. When you have set all the desired limits, save the procedure to memory.

   To clear any previously set limits, recall the procedure from memory and change the limits to the maximum range available. Then save the procedure to memory.

7. **DISPLAY RECALL KEY:** To view other information about the active welding procedure, press the DISPLAY RECALL key. The display window will show the procedure description and gas type of the last active procedure for as long as the key is held depressed. When the key is released, the wire size, material type, and process descriptions will be displayed for a few seconds.

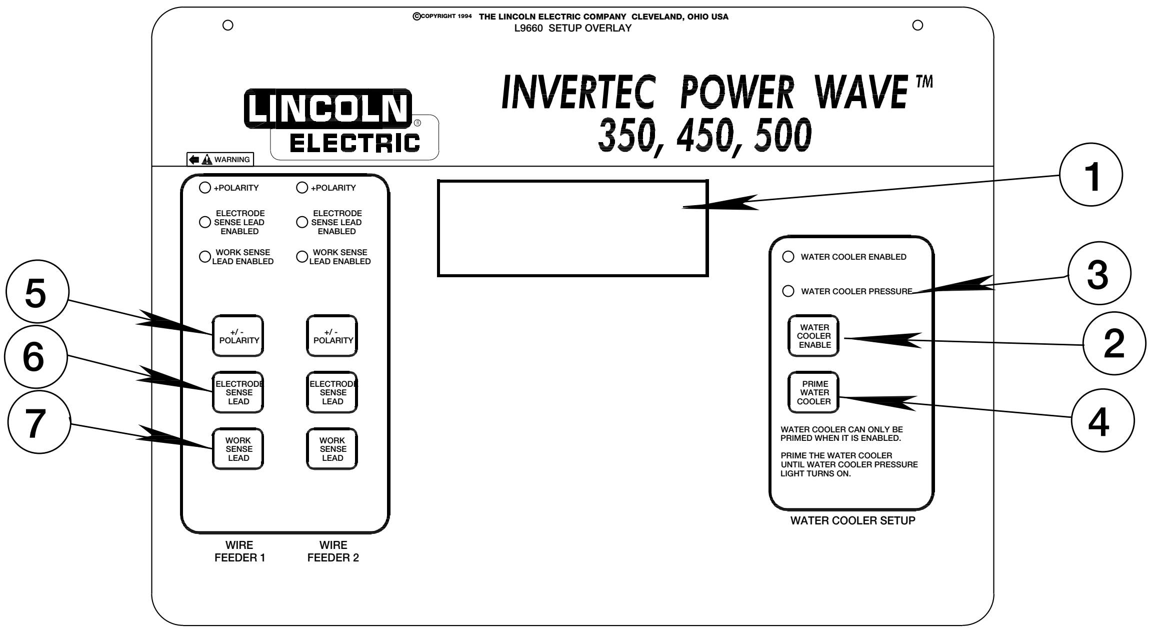
6. **MEMORY LIGHTS:** A memory light is on when its corresponding memory is selected. This tells you what memory is active at any given time.

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SETUP OVERLAY

The Setup Overlay is used to control the water cooler operation (on/off and prime the water cooler), and to set up the voltage sensing configuration of the machine and wire feeder(s) connected to the Power Wave. See Figure B.9.

FIGURE B.9 – SETUP OVERLAY



1 LCD DISPLAY WINDOW
2 WATER COOLER ON/OFF KEY
3 WATER COOLER PRESSURE LIGHT
4 PRIME WATER COOLER KEY
5 WIRE FEEDER 1+/- POLARITY KEY
6 WIRE FEEDER 1 ELECTRODE SENSE LEAD KEY
7 WIRE FEEDER 1 WORK SENSE LEAD KEY

1. **LCD DISPLAY WINDOW:** Power up the machine with this overlay in place. When the Power Wave is turned on, the following message appears in the display window for a few seconds:

   LINCOLN ELECTRIC
   Version X.X

   This display is followed by:

   OVERLAY ID
   NUMBER = 0

   This message is then replaced by the following message:

   POWER WAVE
   SETUP

2. **WATER COOLER ON/OFF KEY:** Press this key to toggle the water cooler between being enabled and disabled. The present status of the water cooler is indicated by the "WATER COOLER ON" light.

3. **WATER COOLER PRESSURE LIGHT:** This light indicates whether or not the coolant flow rate is high enough for normal water cooler operation. If the water cooler loses the required flow rate it will shut down within a couple of seconds, the water cooler pressure light will turn off,and the machine sounds a buzzer.

4. **PRIME WATER COOLER KEY:** The water cooler may have to be primed if there is not enough coolant in the system for proper operation. Make sure that the water cooler has been turned on before it is primed. (The "WATER COOLER ON" light should be turned on.) Check reservoir for proper coolant level - See Water Cooler information in ACCESSORIES section. To prime the water cooler, hold the PRIME WATER COOLER key down. While this key is pressed, the display will show:

   PRIME WATER
   COOLER

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When the "WATER COOLER PRESSURE" light turns on, release the key. If this key has been pressed for 30 seconds and the 'WATER COOLER PRESSURE' light still did not turn on, check the water cooler for adequate fluid level.

5. **WIRE FEEDER 1 +/- POLARITY KEY:** Press this key to change the present voltage sensing polarity of wire feeder 1. The present polarity of wire feeder 1 is indicated by the "WIRE FEEDER 1+ POLARITY" light. If wire feeder 1 is set for positive voltage sensing polarity, this light is turned on.

6. **WIRE FEEDER 1 ELECTRODE SENSE LEAD KEY:** Press this key to enable or disable the electrode sense lead (lead #67) of wire feeder 1. When enabled, voltage sensing is done by the electrode sense lead. When disabled, voltage sensing is done at the Power Wave output terminal. When enabled, the "WIRE FEEDER 1 ELECTRODE SENSE LEAD ENABLED" light will be illuminated.

7. **WIRE FEEDER 1 WORK SENSE LEAD KEY:** Press this key to enable or disable the work sense lead (lead #21) of wire feeder 1. When enabled, voltage sensing is done by the work sense lead. When disabled, voltage sensing is done at the Power Wave output terminal. When enabled, the "WIRE FEEDER 1 WORK SENSE LEAD ENABLED" light will be illuminated.

WIRE FEEDER SETUP DESCRIPTION

The Power Wave may be set up for either positive or negative arc voltage sensing using any two of the following places:

1. the positive output terminal of the Power Wave
2. the negative output terminal of the Power Wave
3. the electrode sense lead (67 lead) of the wire feeder
4. the work sense lead (21 lead) of the wire feeder

The SETUP Overlay allows you to select between which two places arc voltage will be sensed. Once the selection is made it is not necessary to reconfirm the selection every time a new overlay is used or a wire feeder is replaced with another one. The selection will remain until it is changed with the SETUP Overlay.

When welding with a stick procedure, the arc voltage is automatically measured between the Power Wave's output studs.

I. Select arc voltage sensing polarity first.

+/- **POLARITY KEY**

A. **Positive Voltage Sensing Polarity:**

In most welding applications the electrode cable is connected to the + output terminal and the work cable is connected to the - output terminal of the power source. This is the positive voltage sensing polarity, illustrated by ***Figure B.10.*** When the Power Wave and the wire feeder(s) are connected in this manner, the arc voltage can be measured in one of four ways. These four ways are shown in Table B.1.

Table B.1: Positive Voltage Sensing Options

Positive Voltage Reference	Negative Voltage Reference
+ Output Terminal	- Output Terminal
+ Output Terminal	Work Sense (21) Lead*
Electrode Sense (67) Lead	- Output Terminal
Electrode Sense (67) Lead	Work Sense (21) Lead*

* Consult the factory before using this option.

Use the **ELECTRODE SENSE LEAD KEY** to select either the + output terminal or the electrode sense (67) lead for the positive voltage reference.

The work sense (21) lead is used only in rare circumstances. For most installations, use the **WORK SENSE LEAD KEY** to select the - output terminal for negative voltage reference. Consult the factory if use of the work sense (21) lead is desired.

B. **Negative Voltage Sensing Polarity:**

In some welding applications (such as Innershield®) the electrode cable is connected to the - output terminal and the work cable is connected to the + output terminal of the power source. This is the negative voltage sensing polarity, illustrated by ***Figure B.11.*** When the Power Wave and the wire feeder(s) are connected in this manner, the arc voltage can be measured in one of four ways. These four ways are shown in Table B.2.

Table B.2: Negative Voltage Sensing Options

Positive Voltage Reference	Negative Voltage Reference
– Output Terminal	+ Output Terminal
– Output Terminal	Work Sense (21) Lead*
Electrode Sense (67) Lead	+ Output Terminal
Electrode Sense (67) Lead	Work Sense (21) Lead*

* Consult the factory before using this option.

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Use the **ELECTRODE SENSE LEAD KEY** to select either the - output terminal or the electrode sense (67) lead for the positive voltage reference.

The work sense (21) lead is used only in rare circumstances. For most installations, use the **WORK SENSE LEAD KEY** to select the - output terminal for negative voltage reference. Consult the factory if use of the work sense (21) lead is desired.

The two wire feeders can only be connected in the same manner, either by the Positive Polarity or the Negative Polarity setup.

FIGURE B.10

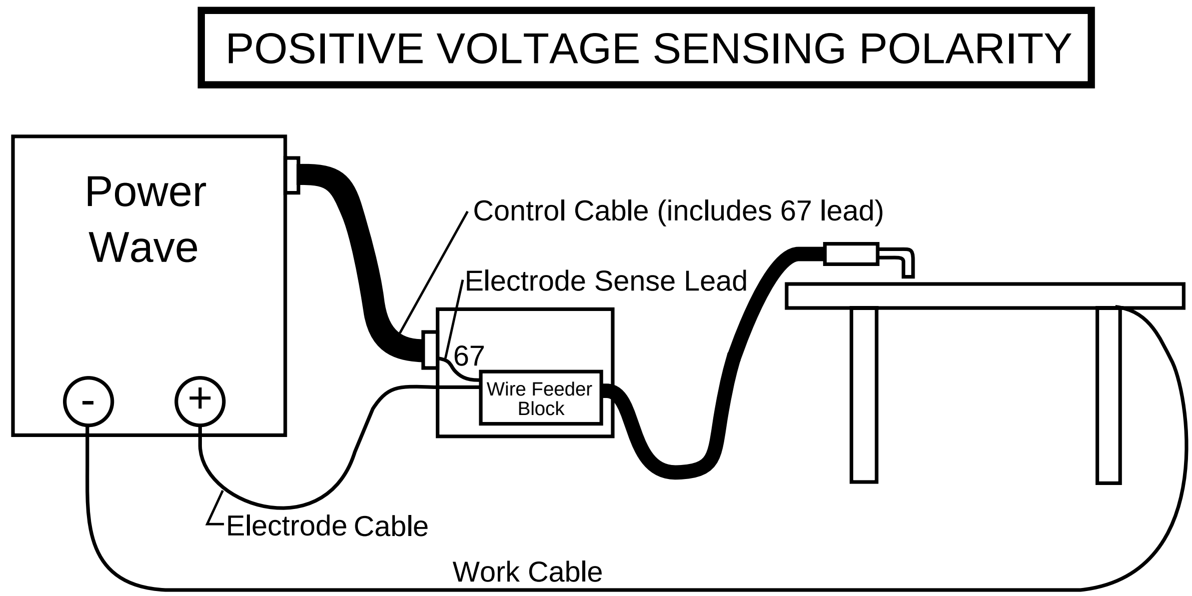
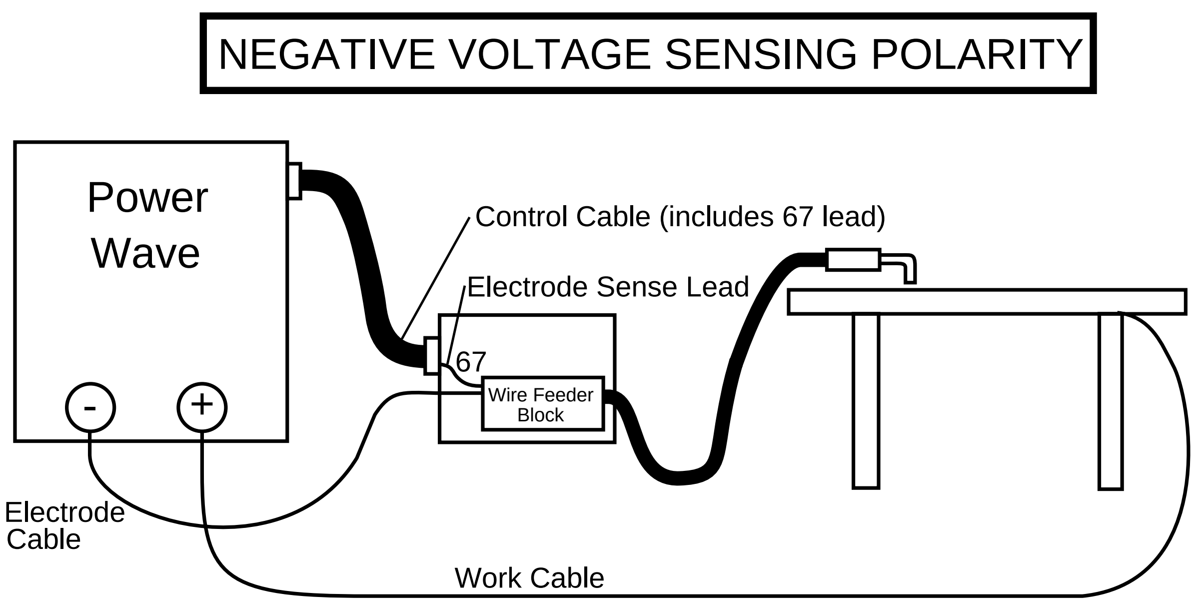


FIGURE B.11



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OVERVIEW OF WELDING PROCEDURES

FLUX CORED ARC WELDING (FCAW) AND GMAW PROCEDURES

For each wire feed speed, a corresponding voltage has been preprogrammed into the machine by welding experts. This preprogrammed voltage is the best average voltage for the procedure at the given wire feed speed. If the wire feed speed is changed on the wire feeder, the voltage automatically changes with it.

In some cases, the operator may want to change the preprogrammed voltages; for example, to compensate for cable and fixture voltage drops. The preset voltages can be adjusted on the wire feeder's Voltage display. When a change is made to the voltage at one wire-feed speed, this change is applied to all other wire feed speed settings. For example, if the operator turns up the voltage by 10 percent, the machine automatically increases the preset voltages at all the other wire feed speeds by 10 percent. In the GMAW FCAW process, the display shows the Procedure Description, WFS and Preset Voltage. The preset voltage which was programmed at the factory, may be changed on the wire feeder voltage display. Note that, if you change the default preset voltage up or down, a respective "Λ" or "V" sign will be displayed after the preset value. When the gun trigger is pulled, note that the display changes to show WFS, Actual Arc Voltage and Actual Arc Current. See ***Table B.5*** for display summary.

PULSE PROCEDURES

In these procedures, the actual voltage greatly depends on the waveform used. The peak currents, background currents, rise times, fall times, and pulse times all affect the actual voltage. The actual voltage for a given wire feed speed is not directly predictable unless the waveform is known. In this case, it is not practical to preset an actual voltage for the procedure. Instead, an arc length adjustment is provided. The machine "knows" what the best arc length is at the given wire feed speed but allows the operator to change it.

The arc length can be adjusted between 0.5 and 1.5 on the wire feeder's Voltage display. An arc length trim of 1.0 means that no adjustments will be made to the preset arc lengths. An arc length trim greater than 1.0 increases the preset arc lengths. An arc length trim less than 1.0 decreases the preset arc lengths. The arc length adjustment is factored in at all wire feed speed settings. Refer to ***Table B.6*** for summary of arc length trim.

Increasing the arc length by 10 percent at a given wire feed speed also increases all the other arc length settings of the procedure by 10 percent. In the GMAW Pulse process, the display shows the Procedure Description, WFS and Arc Length Trim. Arc length trim is programmed to a default at the factory and may be adjusted on the wire feeder. When the trigger is pulled, the WFS, Actual Arc Voltage and Actual Arc Current are displayed.

STICK/TIG PROCEDURES

Stick welding can be performed with the Power Wave by attaching a remote control kit to the 6-pin amphenol on the front of the machine. The K941-1 remote control kit is recommended. Select the stick process from either the GMAW Pulse, GMAW FCAW, stick process selection overlay, or recall it from a previously stored memory location with a Weld From Memory overlay. When this process is selected, the Power Wave reads the current (amps) setting from the remote control kit. It also controls the output of the machine based on the position of the Output Terminals switch, which is also located on the remote control kit. When this switch is in the ON position, the output terminals of the Power Wave are electrically hot. When the switch is in the OFF position, the output terminals of the Power Wave are electrically cold and the machine cannot produce an output. In the stick process, the LCD display shows Procedure Description, and Preset Current (SET=). The Current Trim is always equal to 1 (T=1.00). When the trigger is pulled the Preset Current, Actual Arc Voltage and Actual Arc Current are displayed.

See ***Tables B.3*** through B.6 for a summary of the information discussed above.

WAVE CONTROL

The wave control settings of all procedures can be changed on the Power Wave GMAW Pulse, GMAW FCAW, Stick Process Selection Overlay. The wave control is a setup parameter that may be adjusted when the welding procedures are set. This feature provides an easy way to change the arc behavior without creating a new procedure. The wave control setting of a procedure limits the speed at which the current waveform of that procedure can change. Typically, each procedure is programmed to have average wave control (at the center of the scale).

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TABLE B.3 – RELATIONSHIP BETWEEN VOLTAGE TRIM AND PRESET VOLTAGE

Voltage Trim	Relationship to Preset Voltage
0.6	60% of preset voltage
0.8	80% of preset voltage
1.0	no change to preset voltage
1.2	120% of preset voltage
1.4	140% of preset voltage

Explanation of Table B.3:

If, for example, the minimum voltage trim is set to 0.8 and the maximum voltage trim is set to 1.4, this means that the voltage for a given wire feed speed can be adjusted to be anywhere between 80% and 140% of the preset voltage of that wire feed speed.

TABLE B.6 – RELATIONSHIP BETWEEN SELECTED ARC LENGTH TRIM AND PRESET ARC LENGTH AS INDICATED BY ARC LENGTH

Arc Length Trim	Preset Arc Length
0.6	60% of preset length
0.8	80% of preset length
1.0	no change to preset length
1.2	120% of preset length
1.4	140% of preset length

TABLE B.4 – ADJUSTABLE PARAMETERS

Adjustable Parameters	GMAW Pulse	GMAW FCAW	Stick
Wire Feeder WFS Display	Wire Feed Speed	Wire Feed Speed	—
Wire Feeder Voltage Display	Arc Length Trim	Preset Voltage	—
Power Wave 450 Display (with GMAW Pulse, GMAW FCAW, Stick Process Selection Overlay)	Wave Control (Frequency)	Wave Control (Inductance)	Wave Control (Arc Force)

TABLE B.5 – DISPLAYS OF THE POWER WAVE AND WIRE FEEDERS FOR DIFFERENT PROCESSES IN BOTH TRIGGER POSITIONS

Trigger Position[1]	Power Wave 450			Wire Feeder	
	GMAW Pulse	GMAW FCAW	STICK[1]	GMAW Pulse	GMAW FCAW
Open	WFS and Arc Length Trim	WFS and Preset Voltage	Preset Current	WFS DISPLAY: Wire Feed Speed VOLTAGE DISPLAY: Arc Length Trim	WFS DISPLAY: Wire Feed Speed VOLTAGE DISPLAY: Preset Voltage
Closed	WFS, Actual Arc Voltage, Actual Arc Current	WFS, Actual Arc Voltage, Actual Arc Current	Preset Current, Actual Arc Voltage, Actual Arc Current	WFS DISPLAY: Wire Feed Speed VOLTAGE DISPLAY: Actual Arc Voltage	WFS DISPLAY: Wire Feed Speed[2] VOLTAGE DISPLAY: Actual Arc Voltage

[1]In Stick, trigger is on Remote Control Kit K941-1.

[2]Arc Current, not wire feed speed, is displayed if a Remote Control Kit is attached to the wire feeder.

In Pulse processes:

The wave control adjustment allows the frequency setting to vary. Increasing the wave control allows the frequency setting to increase, and decreasing the wave control allows the frequency setting to decrease. Varying the wave control setting affects the droplet transfer and allows fine-tuning for different welding positions.

In GMAW and FCAW processes:

The wave control adjusts the inductance. (Inductance is inversely proportional to pinch.) Increasing the wave control setting decreases the inductance, which results in the arc getting colder and pinched tighter. Decreasing the wave control setting increases the inductance, which results in the arc getting wider.

In Stick processes:

The wave control adjusts the arc force. Increasing the wave control setting increases the arc force, making the arc more harsh but less likely to stick. Decreasing the wave control setting decreases the arc force, making the arc softer and smoother.

PULSE WELDING

Some people have trouble getting used to the behavior of the pulsing arc. The parameters programmed into the Power Wave have been thoroughly tested for their ability to deliver a sound weld with good appearance. There are, however, a few things to keep in mind when pulse welding.

Spatter levels are often very low with the pulse welding process. Pulsing is often used to eliminate cleaning operations necessary when using other welding processes.

Fume levels are sometimes lower with the pulsing process. Whether or not you will get lower fume levels depends on the pulsing programs used. Certain waveform characteristics are necessary to get low fume levels. Unfortunately, low fume procedures are harder to weld with than procedures designed to optimize the welding process.

The pulsing process is not slower than other processes. The process is sometimes less forgiving when the arc gets on or ahead of the puddle. More attention must be paid to the weld to avoid losing the puddle. Speed is a matter of deposition rate. All things being equal regarding the joint being welded, the speed will depend on the wire feed speed. The travel speed is maximized by maintaining a very short arc. Often the process is “trimmed” down until the arc “crackles.” The spatter increases slightly, but many of the advantages of pulsing are retained. When welding steel, the Power Wave is designed to run well in this region between pulse and short arc.

The pulsing process greatly affects the heat input to the workpiece. This can be a valuable tool for either increasing or decreasing the heat input with a given process. For instance, it is possible to greatly increase the heat input when welding steel at high deposition rates. On the other hand, it is possible to reduce the heat input using the pulsing process. For example, heat input is reduced greatly with some of the low current stainless steel procedures using the processes programmed into the Power Wave. In all cases, the Power Wave procedures have been checked for their ability to deliver a sound weld. However, the fusion of the weld metal into the workpiece may be affected. It is the responsibility of the user to determine if the welds produced are suitable and sound.

The Power Wave 450 is optimized for use with a 0.75” (1.9 cm) stickout. The adaptive behavior is programmed to support a stickout range from 0.5” to 1.25” (1.3 to 3.2 cm). In the low and high end of the wire feed speed ranges of most processes, the adaptive behavior may be restricted. This is a physical restriction due to reaching the edge of the operating range for the process. It is possible to achieve adaptive behavior for longer stickout lengths. However, shielding gas is often lost when the stickout is too long.

A longer electrical stickout is often used with the pulsing process at higher deposition rates. A long stickout will increase the melt-off rate of the wire. In pulse welding, like other wire welding processes, the arc length is determined by the voltage setting. This voltage is programmed at the factory for each process and wire feed speed. It may be changed using the Voltage setting on the wire feeder.

When adaptive processes are used, the voltage will vary with stickout. The machine must change the voltage to keep a stable arc. It is very important to recognize this. “Actual” arc voltage when welding will vary because the stickout will seldom be held at the nominal 1.9 cm value.

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OVERLOAD PROTECTION

THERMAL PROTECTION

The Power Wave has thermostatic protection from excessive duty cycles, overloads, loss of cooling, and high ambient temperatures. When the power source is subjected to any of these conditions or any of the conditions mentioned above, a thermostat will open. The yellow high temperature light on the case front comes on. See ***Figure B.1*** for location. Machine output is disabled, and welding is not possible until the machine is allowed to cool and the High Temperature Light goes out.

OVER CURRENT PROTECTION

The Power Wave 450 is limited to producing 750 amps peak current. If the average current exceeds 540 amps, then the peak current will be limited to 100 amps until the average current decreases to under 50 amps.

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OPTIONS/ACCESSORIES

- Synergic 7 wire feeder (K632-1) standard speed,or (K632-2) high speed
- MAGNUM 400 gun (K471-2) or 550 gun (K598)
- Internal water cooler
- Undercarriages (Single [K961-1]or Dual [K962-1]Gas Cylinders)
- Remote control (stick welding) K941-1
- Amptrols (Hand K963-1 or -2, Foot K870)
- Limits Overlay K946-4
- Dual Wire Feeders, Dual Procedures Overlay K946-9
- Dual Feeder, Dual Procedure, Memory Selection Overlay K946-12
- Test and Calibration Overlay

WIRE FEEDER SETUP

The Power Wave must be used with wire feeders listed above. Mount the feeder in a location suitable to your needs.

For most applications, connect the electrode cable between the feeder and the positive (+) connection of the power source. When negative electrode polarity is required, such as in some Innershield™ applications, connect the electrode cable between the feeder and the negative (-) connection of the power source. See Figure C.1.

Connect the control cable between the feeder and power source. The cable has different connectors on each end and will fit in only one way. If only one feeder is used, it must be connected to the Feeder 1 Amphenol located on the back panel in the upper left-hand corner (as you view the machine from the back). If a second feeder is used, it must be plugged into the Feeder 2 Amphenol receptacle located just to the right of the Feeder 1 Amphenol receptacle.

Connect the work cable between the work and the negative (-) connection of the power source. When negative electrode polarity is required, such as in some Innershield™ applications, connect the work cable between the work and the positive (+) connection of the power source. See Figure C.1.

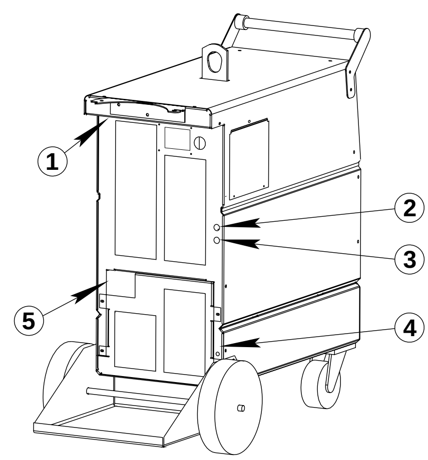
- Connect the feeder to a welding gas supply.
- Load the wire into the feeder and gun.
- Configure wire feeders (Refer to Setup overlay in operation section.

GUNS AND CABLES

Several MAGNUM guns are recommended for use with the Power Wave as shown in Table C.1.

Place the proper liner in the gun and connect the gun to the feeder. Consult the specific instructions supplied with the gun for detailed operating instructions.

FIGURE C.1 – WIRE FEEDER AND WATER COOLER CONNECTIONS



1 WIRE FEEDER CONNECTIONS (LOCATION)
2 WATER COOLER LINE (IN)
3 WATER COOLER LINE (OUT)
4 CIRCUIT BREAKER (WATER COOLER)
5 FILL SPOUT (WATER COOLER)

Using a water-cooled gun is recommended to reduce the size of the gun and improve parts life. The Power Wave comes with a standard internal water cooler. However, an external cooler may also be used.

TABLE C.1 – RECOMMENDED GUNS FOR USE WITH POWER WAVE 450

Gun	Application	Cooling	Product No.
MAGNUM 400	GMAW	Gas	K471-2
MAGNUM 550	GMAW	Gas	K598

WATER COOLER USAGE

The Power Wave is equipped with an optional internal water cooler. We recommend using the water cooler when welding above 300 amps with argon blends on a regular basis. The gun heating from pulsing above 300 amps average current is often excessive and leads to reduced consumable life, reduced gun life, and operator discomfort. Water cooling greatly increases the durability of the gun and parts at high current.

[1]Use of the Synergic 7 wire feeder requires appropriate input cable assembly, wire stand, and drive roll kit. Refer to Synergic 7 Operators Manual for available options.

There are two water connections on the rear of the Power Wave. ***See Figure C.1.*** Connect the water lines between these connectors and those on the wire feeder. The water is fed through the feeder into the gun. When a water cooler is used, the water cooler must be enabled by using the Setup Overlay.

The water cooler contains a flow switch, which is closed when there is adequate coolant circulating in the system. If this flow rate drops below the switch manufacturer's set point, the flow switch opens. A couple of seconds after the flow switch opens the water cooler shuts down. If the water cooler is enabled and the flow switch opens, the machine beeps loudly indicating that there is a problem with the water cooler operation.

RECOMMENDED COOLANTS

1. The following coolants have been determined to be compatible with the wetted materials used in the G3503-[ ] cooler assembly:
   - Distilled or deionized water
   - Potable tap water
   - Sediment-free mixtures containing a maximum of 50% ethylene glycol or automotive-grade antifreeze and the balance of distilled or deionized water.

2. Ethylene glycol mixtures should be selected if the cooler may be exposed to a temperature below the freezing point of water.

3. Consult gun, torch, and wire feeder manuals for coolant recommendations and select one from the above list.

4. Pure solutions and mixtures of, or materials (i.e. towels) wetted with ethylene glycol are toxic to humans and animals. They must not be haphazardly discarded, especially by pouring liquids down the drain. Contact the local EPA office for responsible disposal methods or for recycling information.

5. The cooler's reservoir has a nominal liquid capacity of 1.6 gallons.

PRIMING THE COOLER

1. Select a recommended coolant and fill cooler to specified level (see Fig. C.2).

2. Attach desired water-cooled accessory (gun and wire feeder or TIG torch) to cooler's QDs.

3. Prime the cooler:

   a. Install the Set-up overlay.

   b. Keep accessories' hose lengths horizontal, either coiled or straight, and no higher than 4 feet of the specified coolant level.

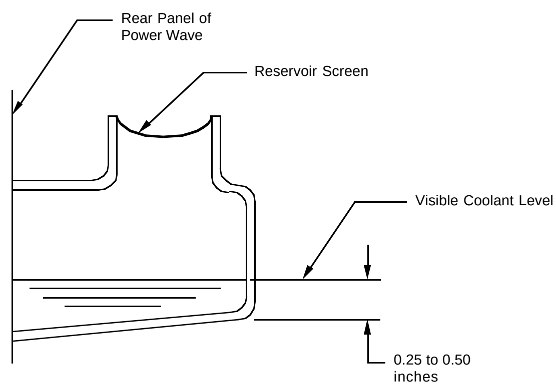
   c. Switch on the Power Wave machine.

   d. Press the "WATER COOLER ENABLE" button so that the "WATER COOLER ENABLED" light is illuminated.

   e. Press the "PRIME WATER COOLER" button until the "WATER COOLER PRESSURE" light is steadily illuminated.

4. Check coolant level. Add more if required.

Figure C.2



Do Not Use: Any prepacked welding industry coolant mixture, such as those offered by Miller, OKI, Bernhard, or Dynaflux. These coolants contain substances which attack plastic components and may shorten the life of the system. Once added, these substances are virtually impossible to purge from the system. DO NOT USE OIL-BASED COOLANTS OF ANY TYPE.

K961-1 Single Cylinder Undercarriage -

Designed for quick installation in the field. Consists of a front caster assembly, a rear platform assembly, a handle, and an upper cylinder support.

K962-1 Dual Cylinder Undercarriage -

Designed for quick installation in the field. Consists of a front caster assembly, a dual bottle rear platform assembly, a handle, and a dual bottle upper cylinder support.

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G3503-[ ] COOLER PERIODIC MAINTENANCE

1. Preparation:
   - Always switch off the Power Wave machine power.
   - Always disconnect the Power Wave machine from service input power.
   - Do not remove the pump relief valves' 3/4 in. acorn hex nut or attempt to adjust the relief valve setting.

2. Remove the G3503-[ ] cooler from the Power Wave machine.

3. Clean the pump's inlet strainer:
   - Drain the reservoir of coolant and dispose of it in an environmentally responsible manner (see Recommended Coolants).
   - Place absorbent towels underneath pump head.
   - Hold pump head to apply countertorque when loosening strainer's 7/8 acorn nut. Do not confuse with 3/4 acorn nut. Remove nut and slide inlet strainer down and out from pump head.
   - Gently rinse strainer under running water to thoroughly clean it.
   - Use the mirror to inspect inside of pump for contamination. Carefully remove hardened debris with dental pick if necessary, without scratching inside of the pump.
   - Reinstall strainer and acorn nut, tightening with 75±15 in.-lbs. of torque. Wipe dry all areas wetted by coolant. Dispose of towels in an environmentally responsible manner (see Recommended Coolants).

4. Gently rinse the reservoir's strainer under running water to thoroughly clean it.

5. Remove fan shroud and inspect hoses and electrical harnesses for kinking or damage (cut, abrasion, swelling, etc.). Replace if necessary.

6. Remove accumulated dust from cooler, especially from the motor and heat exchanger, by blowing it off with shop air or vacuuming it out.
   - The heat exchanger fins are sharp but can be easily bent. Treat them with care to avoid personal injury and damaging them.
   - Remove the cooler from the machine for a more thorough cleaning job.

7. Motor lubrication is recommended once a year:
   - Remove plug over lube port at top of motor near fan end.
   - Add 20 drops of electric motor or SAE 10 oil then reinstall plug.

8. Flush coolant from the system and replace with fresh, recommended coolant at least once a year. More frequent flushing may be necessary, depending upon a user's particular system or its usage.

NOTE: Never run the pump dry. Always use a recommended coolant, otherwise pump damage may result.

9. Reinstall the G3503-[ ] cooler into the Power Wave machine.

G3503-[ ] COOLER SERVICE

1. Preparation:
   - Always switch off the Power Wave machine power.
   - Always disconnect the Power Wave machine from service input power.
   - Do not remove the pump relief valves' 3/4 in. acorn hex nut or attempt to adjust the relief valve setting.

2. Remove the G3503-[ ] cooler from the Power Wave machine whenever:
   - replacing major cooler components (i.e. pump, motor, heat exchanger, etc.).
   - replacing hoses and electrical harnesses that are kinked or damaged (cut, abraded, deteriorated or swollen, etc.).
   - investigating suspect coolant leakage.

3. Pump replacement:
   a. Drain the reservoir of coolant and dispose of it in an environmentally responsible manner (see Recommended Coolants).
   b. Remove fan shroud.
   c. Place absorbent towels underneath pump head and wherever coolant system is opened.
   d. Carefully pull pump inlet hose and its elbow from reservoir (bottom).
   e. Loosen pump outlet hose clamp at QD then carefully remove from fitting.
   f. Disconnect v-band clamp from motor and remove pump:
   - Do not drop or lose drive coupling between pump and motor.
   - Do not discard old pump. Remove both fittings, Keep v-clamp, Seal old pump in a waterproof bag, Package into protective container, and Return to nearest Lincoln Electric FSS center.

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g. Install new pump and v-band clamp:
- Do not apply any lubricant to pump's drive coupling.
- Pump body is properly oriented with its strainer at the 6:00 position.
- Tighten v-clamp with 15 to 30 in-lbs. of torque.

h. Attach coolant lines to QD and reservoir.

i. Wipe dry all areas wetted by coolant. Dispose of towels in an environmentally responsible manner (see Recommended Coolants).

j. Reinstall cooler into machine.

4. Motor removal or replacement:
   - Do not reuse the 4 internal-tooth star washers. Replace with new parts.

5. Installing the fan:
   - Slide onto motor shaft until the fan is located between 0.25 to 0.50 inches from the heat exchanger.
   - Tighten set screw with 65 to 75 in-lbs of torque against motor shaft's flat.
   - Fan rotation is counterclockwise, as viewed from fan-end of motor's shaft.
   - Fan pulls air through the heat exchanger, blows it over the motor, then exhausts it through the reservoir.

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SAFETY PRECAUTIONS

⚠ WARNING

ELECTRIC SHOCK can kill.



- Only Qualified personnel should perform this maintenance.
- Turn the input power OFF at the disconnect switch or fuse box before working on this equipment.
- Do not touch electrically hot parts.

ROUTINE AND PERIODIC MAINTENANCE

Perform the following preventive maintenance at least once every six months.

⚠ WARNING

Prior to performing preventive maintenance it is important to perform the following capacitor discharge procedure to avoid electric shock.

INPUT FILTER CAPACITOR DISCHARGE PROCEDURE

1. Turn off input power and disconnect input power lines.
2. Remove the hex head screws from the top and the sides of the machine. Remove the handle bar and the wrap-around machine cover.
3. Remove the two case sides. There are hex head screws on each side.

⚠ CAUTION

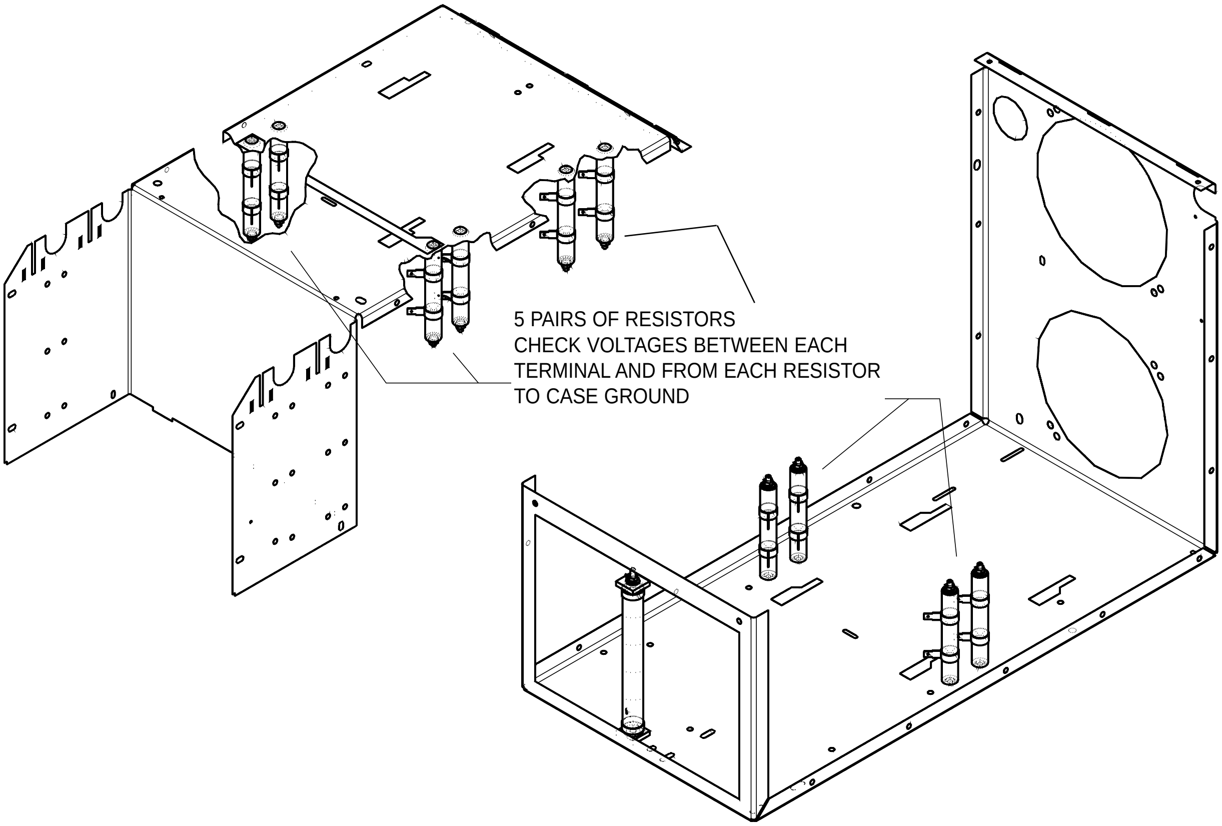
TO PREVENT DAMAGE TO MACHINE, AVOID UNNECESSARY MOVEMENT OF FRONT PANEL.

---

4. Obtain a high resistance and high wattage resistor (25-1000 ohms and 25 watts minimum). This resistor is not supplied with the machine. Secure this resistor to a piece of insulating material such as a glastic board. See ***Figure D.3.*** NEVER USE A SHORTING STRAP FOR THIS PROCEDURE.

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FIGURE D.1 – RESISTOR LOCATIONS



5. Locate two sets of two resistors on the left side of the machine and three sets of two resistors on the right side of the machine. See Figure D.1. Do not touch the resistors or any other internal machine component. Using a DC voltmeter, check for any DC voltage that may be present across the terminals of each resistor and from each resistor to case ground (20 measurements in all). If a voltage is present, be careful not to touch these resistors.

⚠ WARNING



ELECTRIC SHOCK can kill.

- Proceed with caution being careful not to touch any internal machine components during the discharge procedure.

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6. Locate the #9 and #12 terminals, identified by the “Discharge” labels, on each of the four Switch Boards. See Figure D.2.

7. Using insulated, needle nose-type jumper leads and insulated gloves, connect one jumper lead to one end of the resistor obtained in step 4. Connect the other jumper lead to the other end of the resistor.

8. Carefully connect the needle nose end of one of the jumper leads to terminal #9. See Figure D.3. Connect the needle nose end of the other jumper lead to terminal #12. Terminals #9 and #12 are indicated by the “Discharge” label. Leave resistor connected for 10 seconds. DO NOT TOUCH TERMINALS, RESISTORS, OR ANY INTERNAL MACHINE COMPONENT DURING THIS PROCEDURE!

FIGURE D.2 – DISCHARGE LABEL

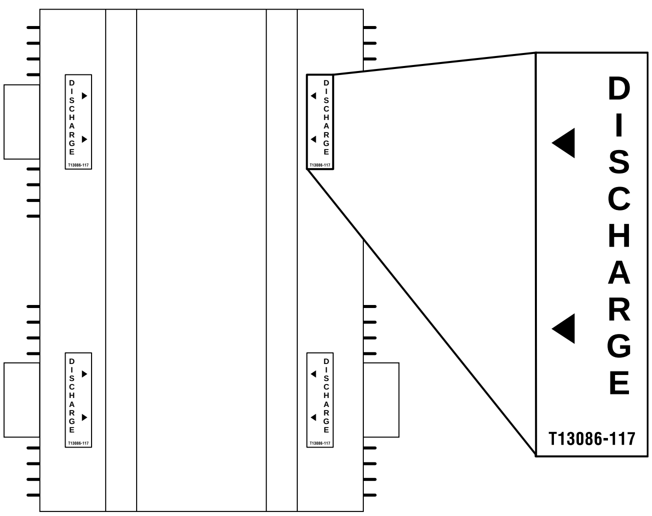
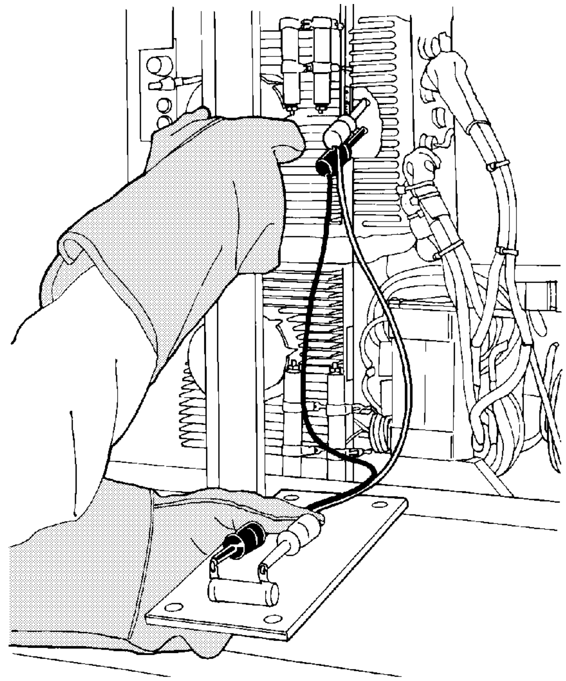


FIGURE D.3 – RESISTORS WITH LEADS CONNECTED



9. Check voltage across terminals (9 and 12) with a DC voltmeter. Terminal 9 has positive polarity and terminal 12 has negative polarity. Voltage should be zero. If any voltage remains, repeat this capacitor discharge procedure.

10. Repeat discharge procedure (steps 7, 8 and 9) for each of the other three Switch Boards.

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PREVENTIVE MAINTENANCE

Perform the following preventive maintenance procedures at least once every six months. It is good practice to keep a preventive maintenance record; a record tag attached to the machine works best.

1. Remove the hex head screws from the sides and top of the machine. Remove the handle bar and the machine wrap-around cover. Remove the two case sides. There are hex head screws on each side.
2. Perform the input filter capacitor discharge procedure described at the beginning of the Maintenance Section.
3. Disconnect the shunt from the negative (-) output terminal. Failure to do this could cause damage to the shunt circuitry.
4. Clean the inside of the machine with a low pressure airstream. Be sure to clean the following components thoroughly (Refer to ***Figure D.4***):
   - Display, Snubber, and Shunt printed circuit boards
   - Power Switch
   - Main Transformer
   - Auxiliary Transformers
   - Input Rectifier
   - Heat Sink Fins
   - Input Filter Capacitors
   - Output Terminals
   - Terminal Strip
5. Examine the capacitors for leakage or oozing. Replace if needed.
6. Examine the wrap-around and side covers for dents and breakage. Repair them as needed. The covers must be kept in good condition to assure that high voltage parts are protected and that correct spacings are maintained.
7. Remove welding cables and check the electrical ground continuity. Use an ohmmeter to measure the resistance between each output terminal and an unpainted surface of the machine case. The meter reading should be 500,000 ohms or more. If the meter reading is less than 500,000 ohms, check for electrical components that are not properly insulated from the case. Correct component insulation, if needed.
8. Reconnect the shunt and wire #467 to the negative (-) output terminal. Make sure the connection is tight.
9. Replace and secure the machine covers and handle bar.
10. Remove the overlay from the front panel of the machine. Clean the plastic case with a low pressure airstream. Wipe the sensors (***Fig D.4*** Item 8) with a clean, soft cloth. Make sure the sensors are not scratched in the process.
11. Check the back of the overlays. If the bar code (black square(s)) on the back of the overlay is scratched, apply a dull black spray finish to the scratched-off areas only. If a large area of the bar code is scratched off, the machine either will not recognize the overlay or will mistake the overlay for another one.
12. Inspect gun and cables for good condition.

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FIGURE D.4 – GENERAL COMPONENT LOCATIONS

1 DISPLAY BOARD (BACK OF PANEL)
2 POWER SWITCH
3 MAIN TRANSFORMER
4 AUXILIARY TRANSFORMER
5 INPUT RECTIFIER
6 HEAT SINK FINS
7 OUTPUT TERMINALS
8 OVERLAY BAR CODE SENSORS
9 TERMINAL STRIP (LOCATION)

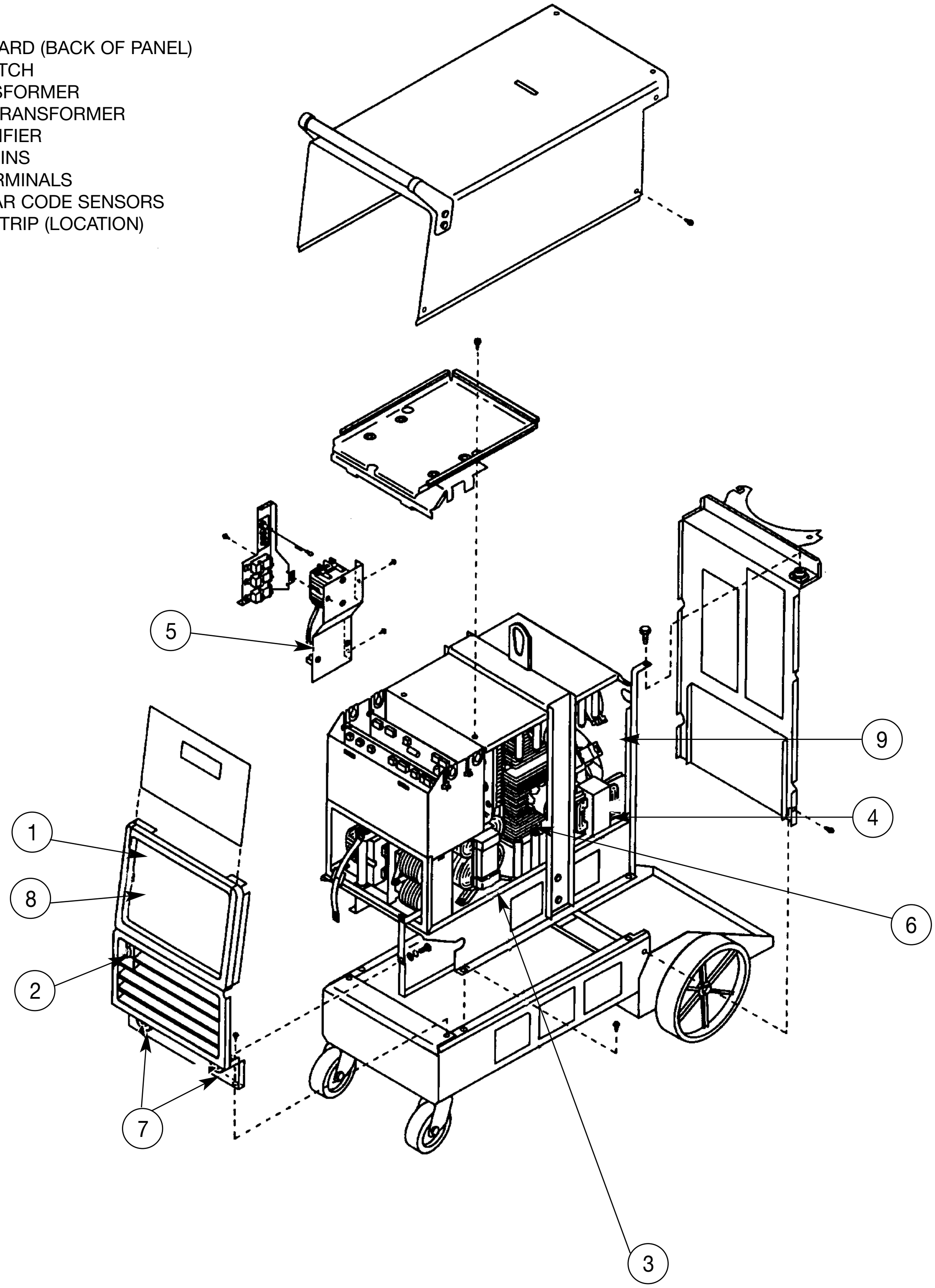


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FIGURE E.1 – POWER WAVE BLOCK LOGIC DIAGRAM

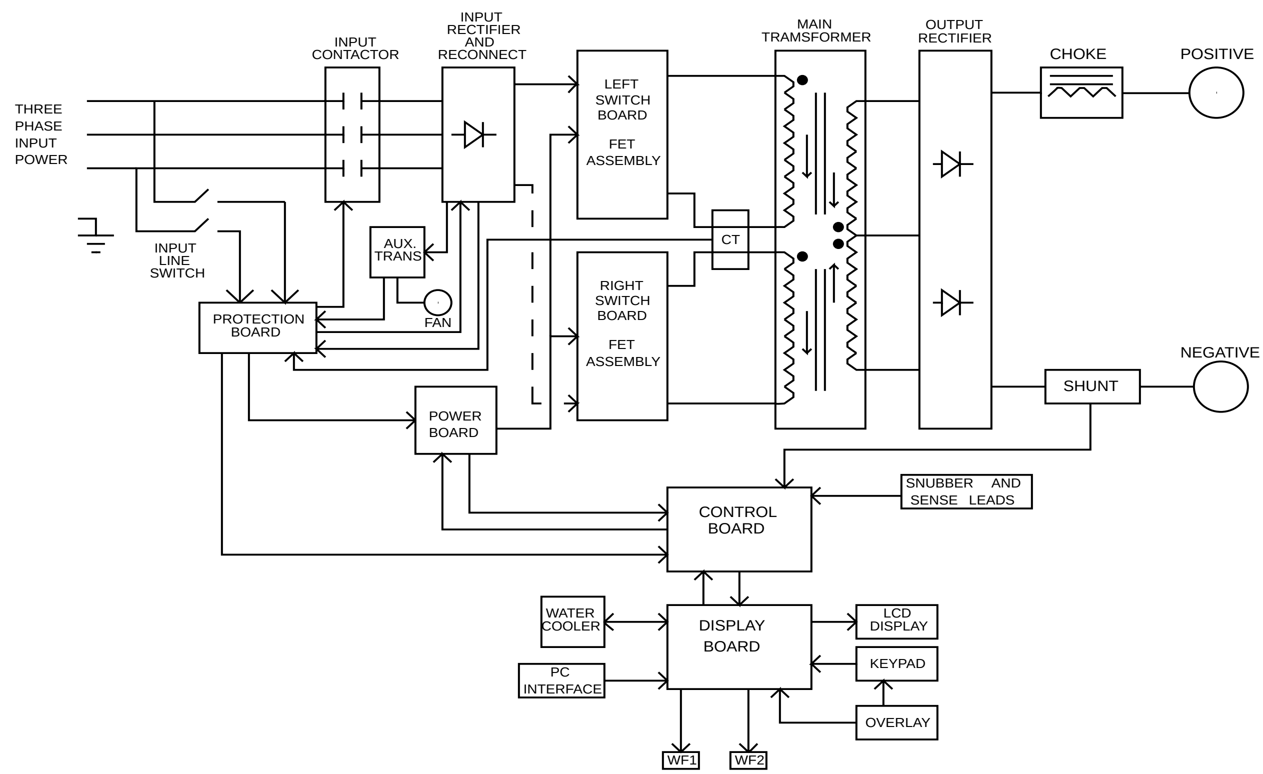
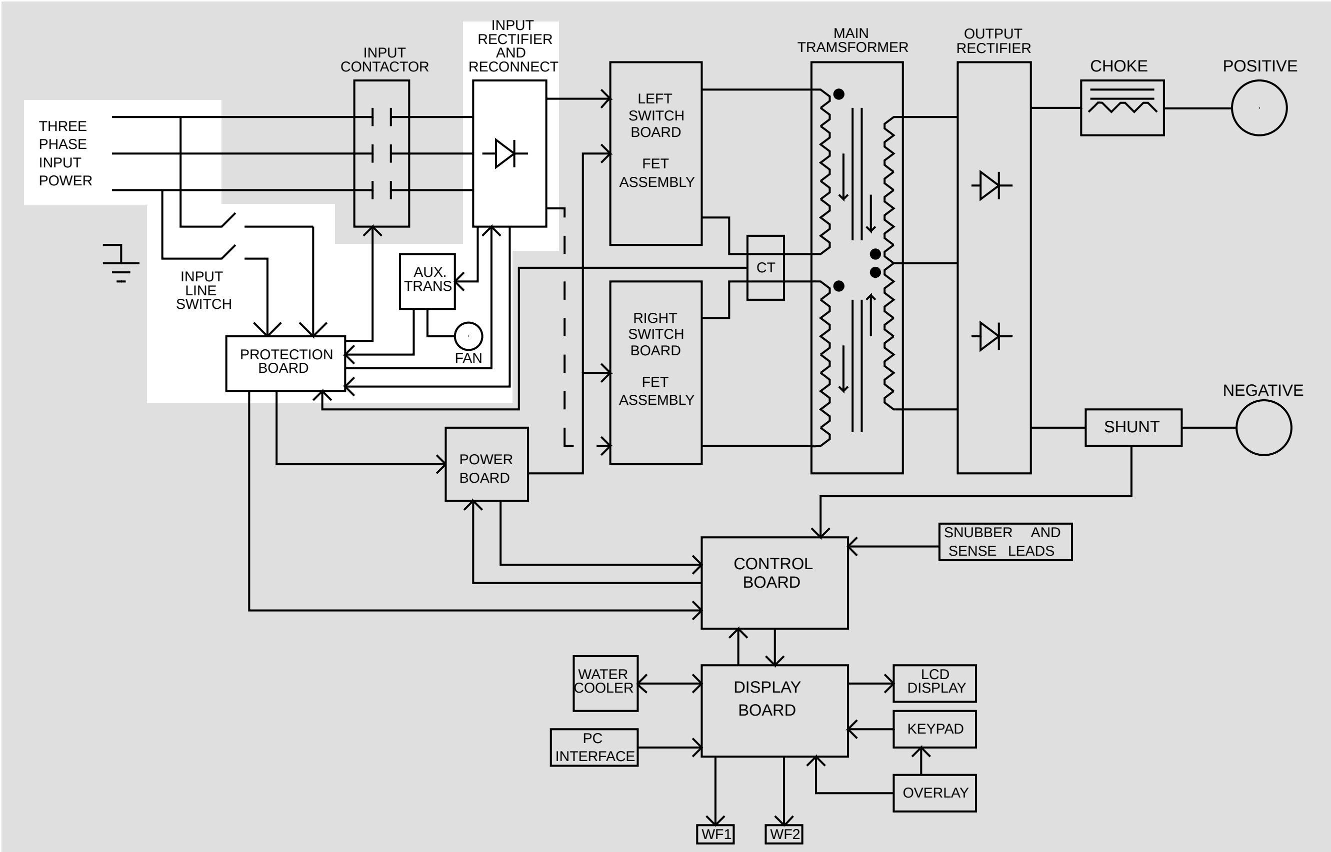


FIGURE E.2 – INPUT VOLTAGE CIRCUIT



GENERAL DESCRIPTION

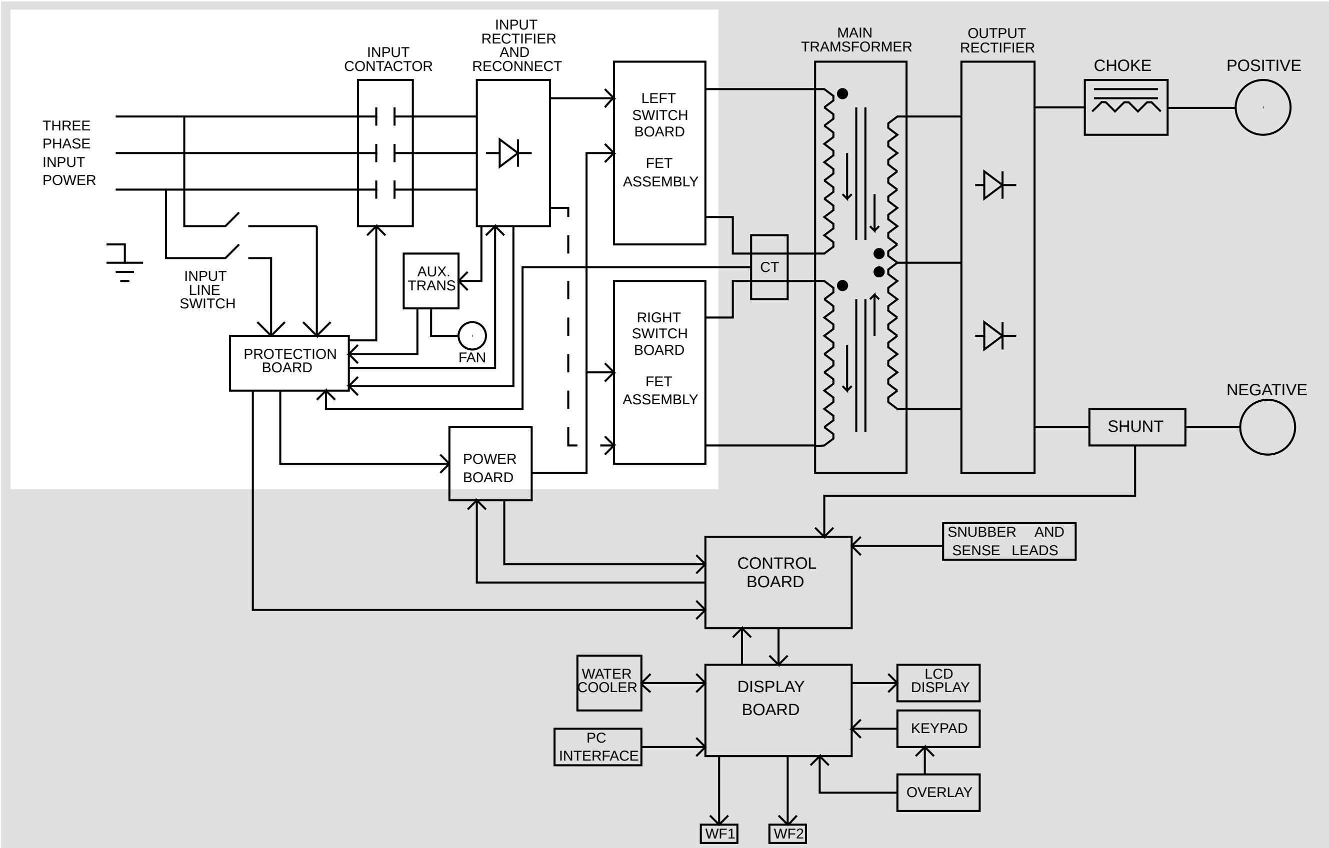
The Power Wave is an inverter type power source that can support most welding procedures. It is modeled after a P.C. (Personal Computer). There are no specific welding characteristics designed into the power portion of the machine. All welding characteristics are programmed into the software package.

INPUT VOLTAGE

The Power Wave can be connected for a variety of three phase voltages. The initial input power is applied to the Power Wave through a line switch located on the front of the machine. The voltage is connected to the Protection Board where it is current limited before being passed on to the input rectifier and reconnect switches. The reconnect panel allows the user to switch to low or high voltage and connect the Auxiliary Transformer to the appropriate input voltage. The Auxiliary Transformer supplies power to the fan motors and, through the Protection Board, to the printed circuit boards and wire feeder(s).

NOTE: Unshaded areas of Block Logic Diagram are the subject of discussion.

FIGURE E.3 – PRECHARGE CIRCUIT



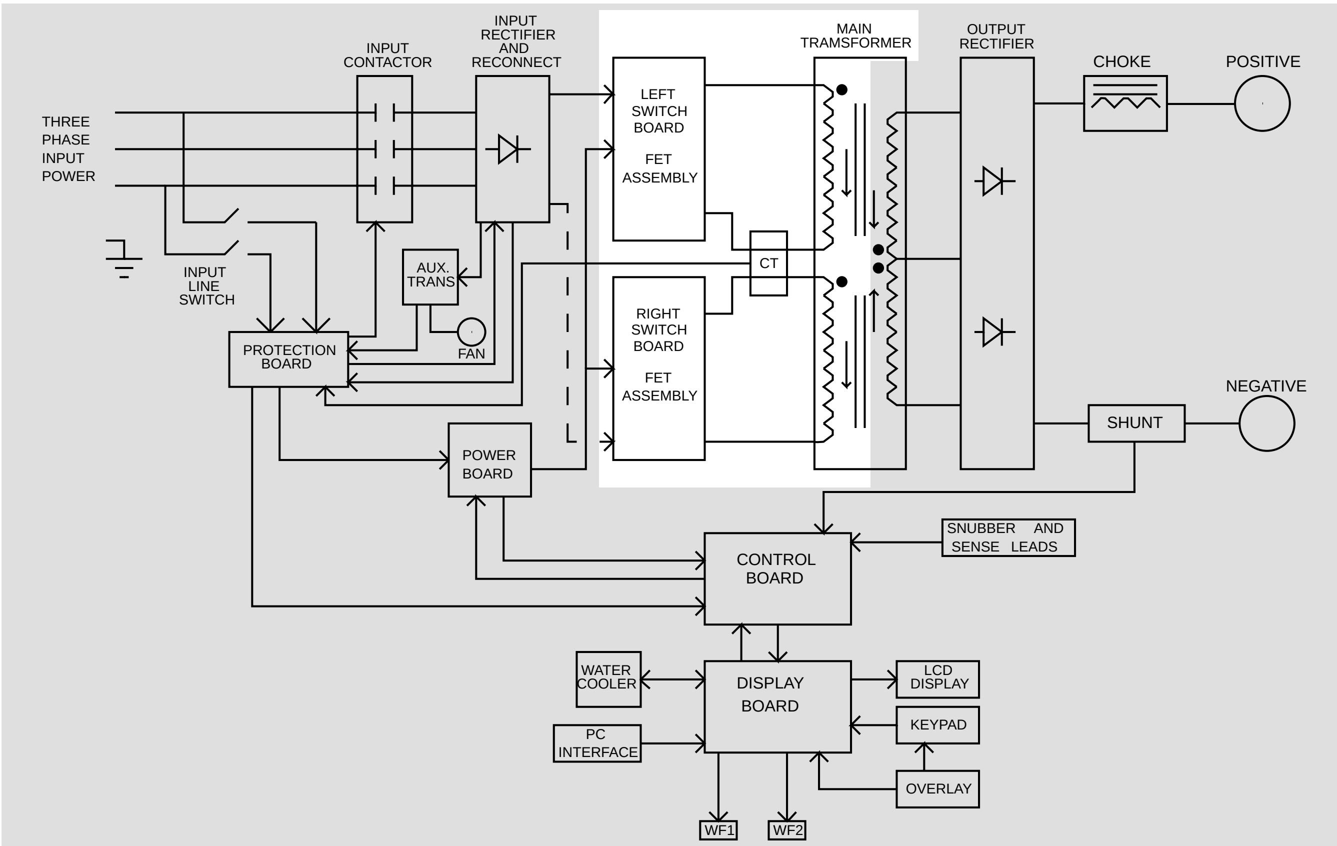
PRECHARGE (SOFT START)

The Protection Board contains a “soft Start” circuit, which is powered by the Auxiliary Transformer. During precharge or “soft start” only two phases of the input power, with current limiting, are connected to the input rectifier. This AC input voltage is rectified, and the DC voltage is applied through the Reconnect Switches to the input capacitors located on the Switch Boards. The Protection Board monitors the voltage across the capacitors. When the capacitors have charged to an acceptable level, the Protection Board energizes the Main Input Contactor, making all three phases of input power available to the input capacitors. At this point the Power Wave is in the “Run Mode” of operation. If the capacitors become under- or overvoltaged, the Protection Board will de-energize the Main Input Contactor, and the machine output will be disabled.

NOTE: Unshaded areas of Block Logic Diagram are the subject of discussion.

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FIGURE E.4 – SWITCH BOARD CIRCUIT



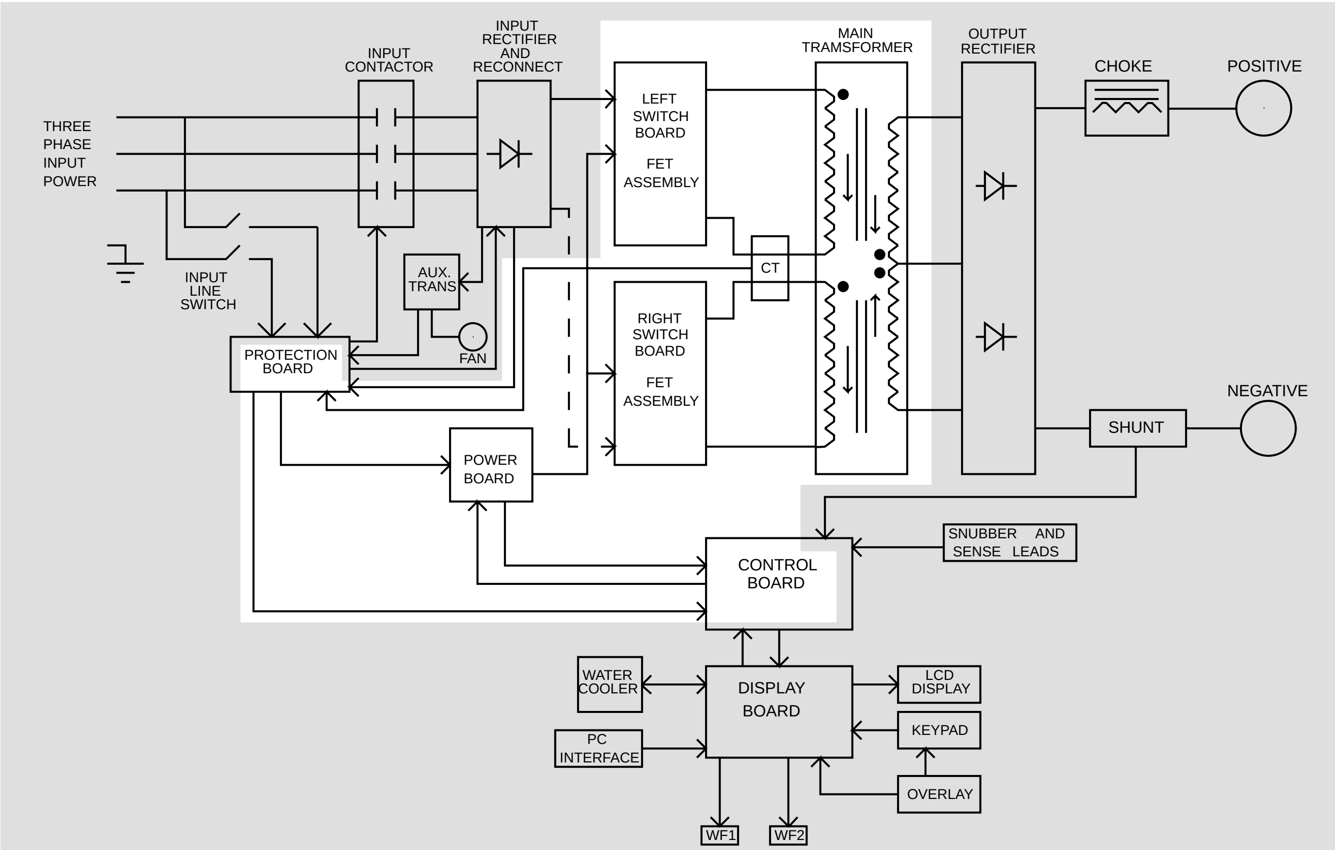
SWITCH BOARDS

There are four Switch Boards in the Power Wave, each containing an input capacitor. The capacitors on Switch Boards #1 and #2 are always in parallel, and the capacitors on Switch Boards #3 and #4 are always in parallel. When the filter capacitors are fully charged, they act as power supplies for the Switch Boards. The Switch Boards contain the Field Effect Transistors (FETs) which, when switched on, supply the Main Transformer primary windings with DC current flow. See FET operation discussion and diagrams ***(Figures E.10*** and ***E11***).

NOTE: Unshaded areas of Block Logic Diagram are the subject of discussion.

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FIGURE E.5 – MAIN TRANSFORMER



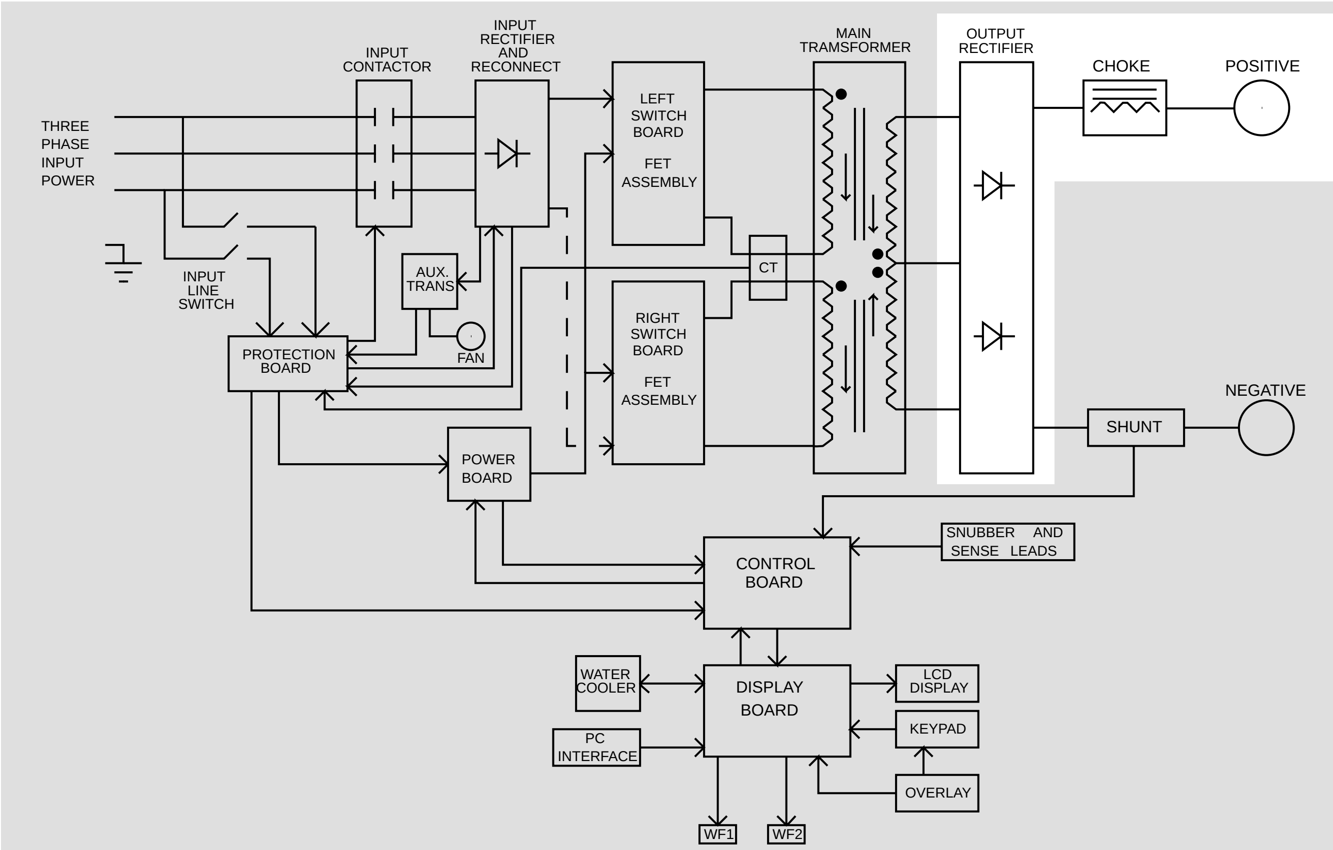
MAIN TRANSFORMER

Each Switch Board assembly works as a switch pair. Each board feeds current to a primary winding of the Main Transformer. These primary currents are monitored by the Current Transformer (CT). The CT sends a signal through the Protection Board to the Control Board. If the primary currents become abnormally high, the Control Board will shut off the FETs, thus disabling machine output. The right and left sides of the transformer are isolated from each other. The right side of the transformer is supplied from Switch Boards #1 and #2, while the left side of the transformer is supplied from Switch Boards #3 and #4. The DC current flow through each primary winding is clamped back to each respective input capacitor when the FETs are turned off. The firing of the four Switch Board pairs occurs during halves of a 50 microsecond interval, creating two constant 20 kHz square waves on the primary side of the transformer. The current flow through the Main Transformer primaries induces a 20 kHz AC square wave output signal at the secondary of the Main Transformer.

NOTE: Unshaded areas of Block Logic Diagram are the subject of discussion.

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FIGURE E.6 – OUTPUT RECTIFIER AND CHOKE



OUTPUT RECTIFIER AND CHOKE

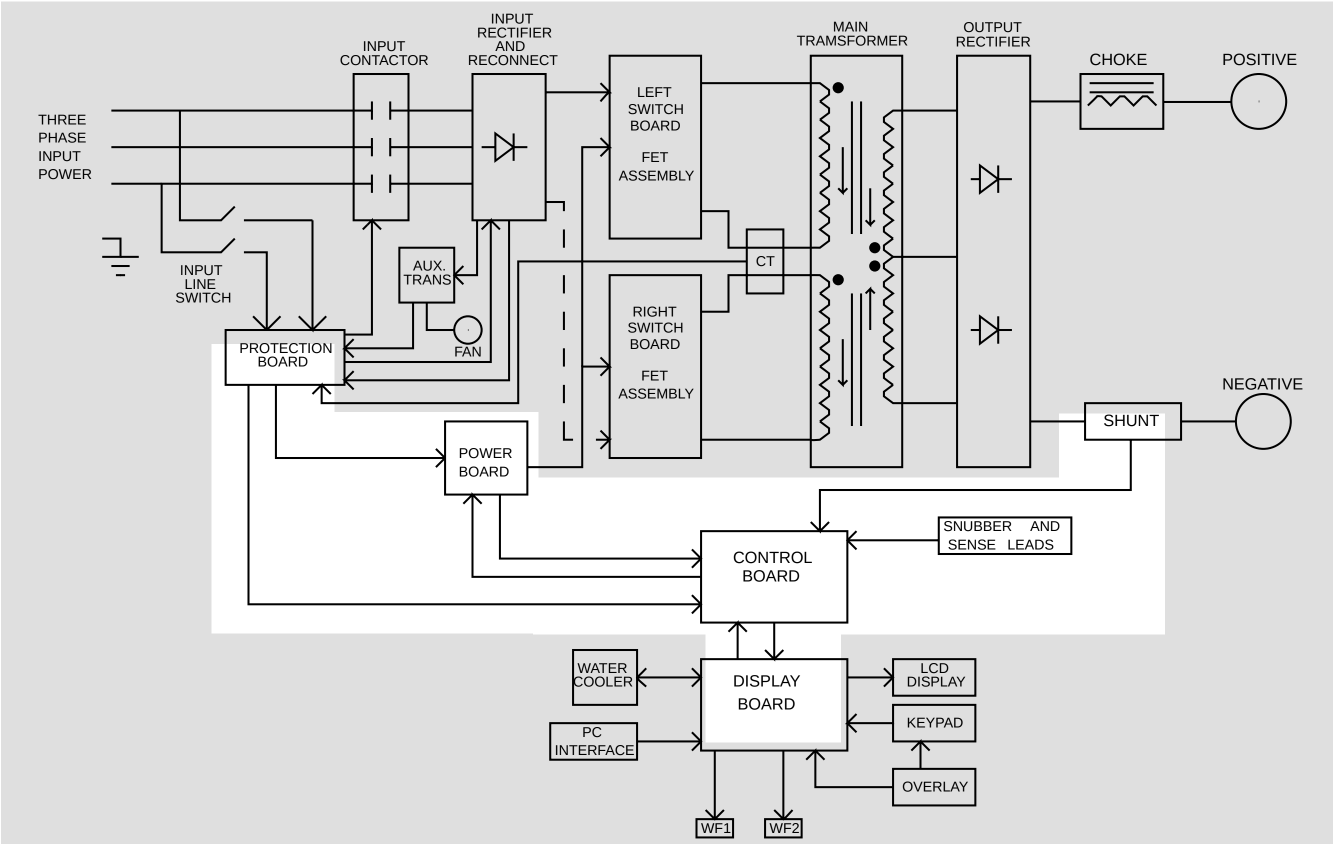
The Output Rectifier receives the AC output from the Main Transformer secondary and rectifies it to a DC level with a 40 kHz ripple.

Since the Output Choke is in series with the positive leg of the Output Rectifier and also in series with the welding load, a filtered DC output is applied to the machine output terminals.

NOTE: Unshaded areas of Block Logic Diagram are the subject of discussion.

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FIGURE E.7 – CONTROL BOARD

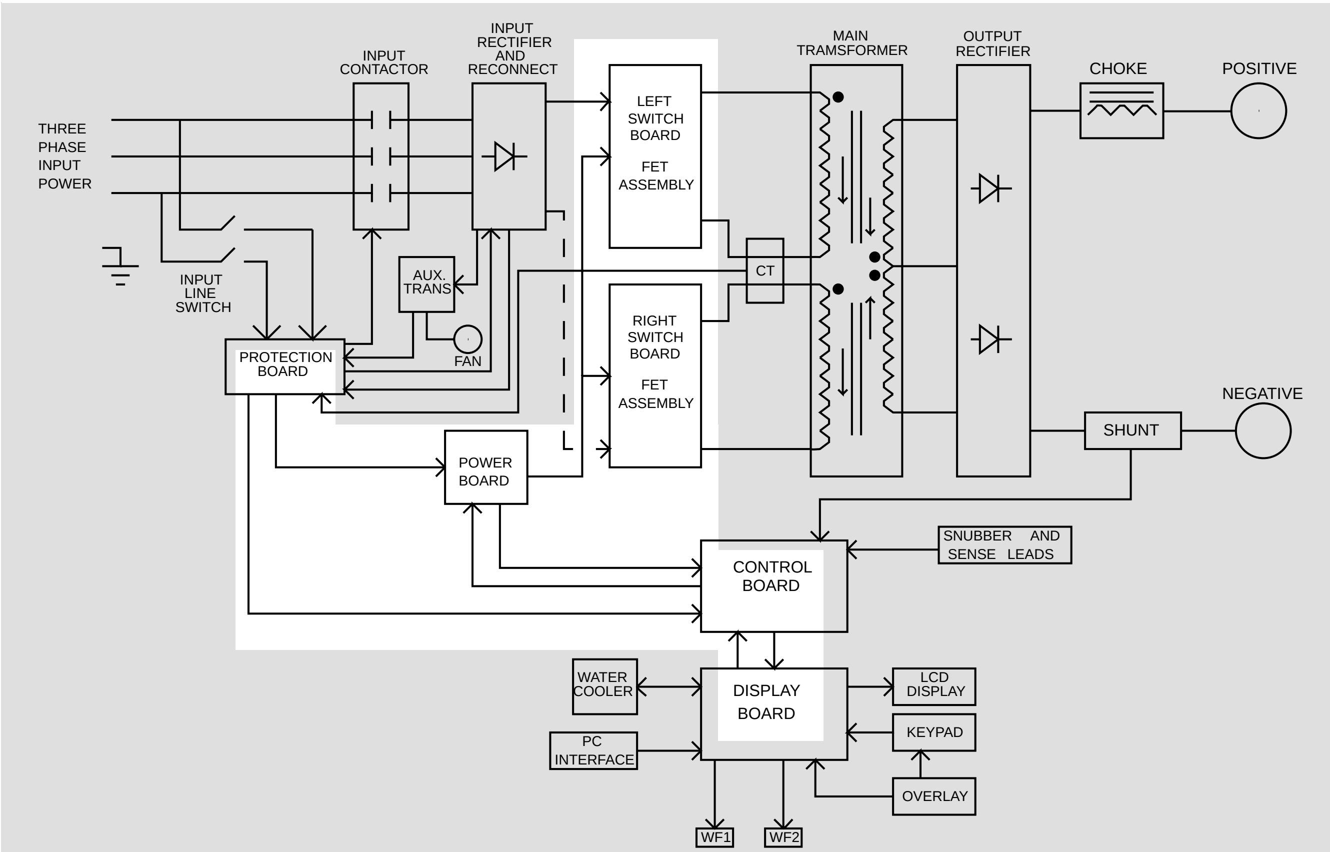


CONTROL BOARD

The Control Board is at the heart of controlling the output of the machine. With the information it receives from the Shunt (current feedback), the voltage sensing leads, the wire feeder(s), and the other printed circuit boards, the Control Board optimizes the welding results by regulating the FETs' switching times, which in turn control the output of the machine. The Control Board also monitors the thermal protection devices and the regulation and fault signals produced on the Protection Board.

NOTE: Unshaded areas of Block Logic Diagram are the subject of discussion.

FIGURE E.8 – POWER BOARD



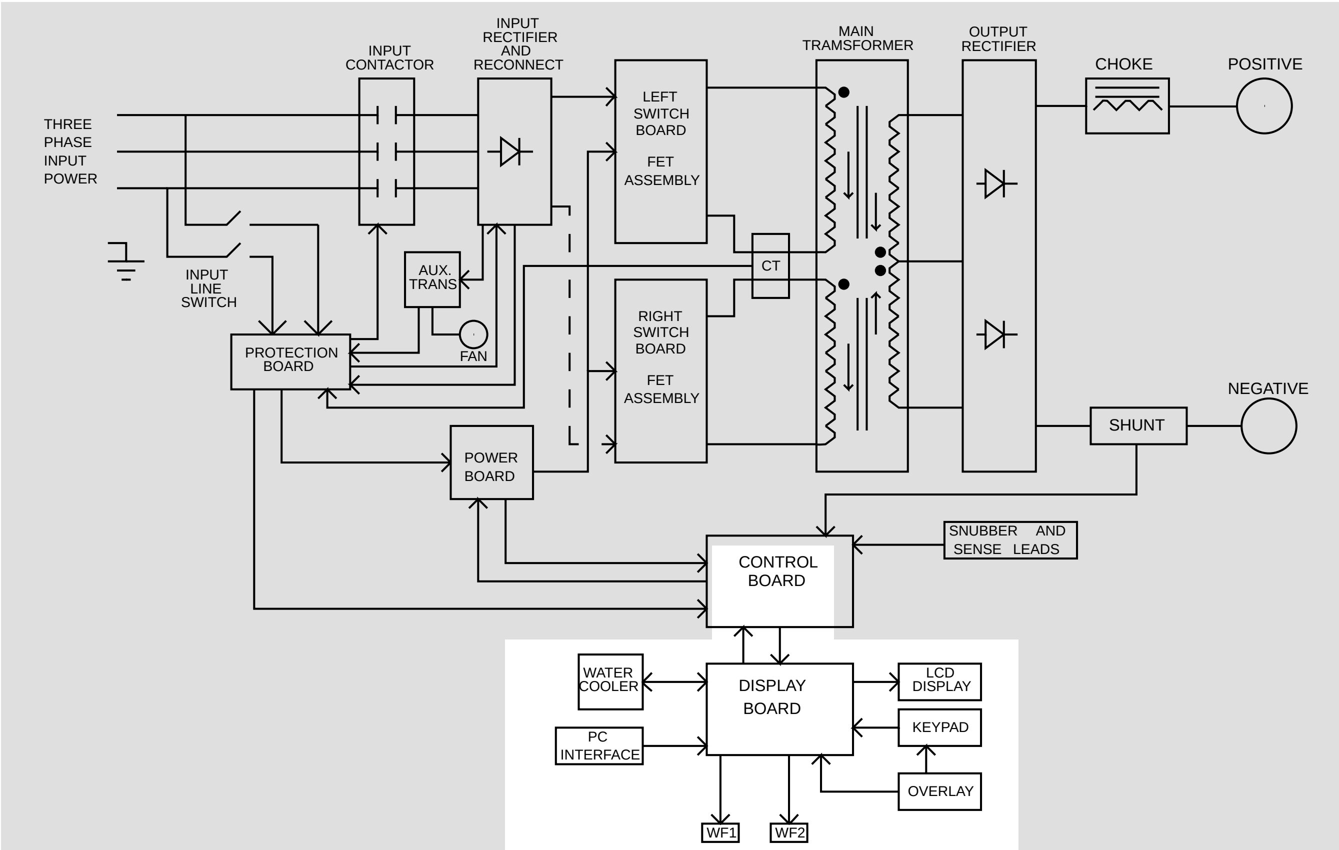
POWER BOARD

The Power Board provides gate drives for the FETs on the Switch Boards. It does so based on the "turn-on" signals it receives from the Control Board. One function of the Power Board is to isolate the Control Board from the Switch Boards. The Power Board also provides the other printed circuit boards with the DC voltage supply they require.

NOTE: Unshaded areas of Block Logic Diagram are the subject of discussion.

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FIGURE E.9 – DISPLAY BOARD



DISPLAY BOARD

The Display Board allows the operator to select from the procedures that are programmed into the machine, and it lets the Control Board know which procedure was selected. These procedures are programmed into the machine's software package. The Display Board is used to communicate with the operator. It determines what Overlay is installed in the machine and which buttons are active on the keypad. It also controls the LCD display, the lights on the front of the machine, the Piezo Buzzer and the water cooler. Through the use of a current serial loop, the Display Board and Control Board communicate (or talk) to the wire feeder(s). The Display Board can also communicate with a computer through the RS232 interface.

NOTE: Unshaded areas of Block Logic Diagram are the subject of discussion.

THERMAL PROTECTION

Two normally closed (NC) thermostats protect the machine from excessive operating temperatures. These thermostats are wired in series and are connected to the Control Board. One of the thermostats is located on the heat sink of a switch board, and the other is located on the main choke. Excessive temperatures may be caused by a lack of cooling air or operating the machine beyond the duty cycle or output rating. If excessive operating temperatures should occur, the thermostats will prevent output from the machine. The displays will remain on during this time; and the yellow Thermal light, located of the front of the machine, will be illuminated. The thermostats are self-resetting once the machine cools sufficiently. If the thermostat shutdown was caused by excessive output or duty cycle and the fans are operating normally, the Power Switch (SW1) may be left on and the reset should occur within a 15-minute period. If one or both of the fans are not turning or the air intake louvers are obstructed, then the power must be removed from the machine, and the fan problem air obstruction must be corrected.

PROTECTIVE CIRCUITS

Protective circuits are designed into the Power Wave to sense trouble and shut down the machine before damage occurs to the machine's internal components.

OVER CURRENT PROTECTION

If the average current exceeds 520 amps, then the peak current will be limited to 100 amps until the average current decreases to under 50 amps.

OVER VOLTAGE PROTECTION

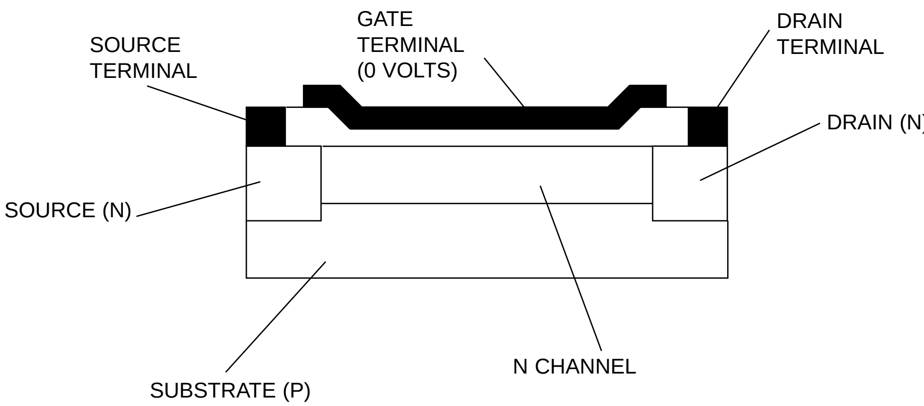
A protective circuit is included on the Protection Board to monitor the voltage across the input capacitors. In the event that a capacitor voltage is too high, the protection circuit will prevent output. Also, in the event that a capacitor voltage is too low, the machine output is disabled and the "soft start" mode is repeated. The protection circuit may prevent output if any of the following circumstances occur:

1. Capacitor condition is required. (Required if machine has been off for a long period of time and is connected for high input voltage operation.)
2. Voltage across a capacitor exceeds 370 volts. (High line surges or improper input voltage connections.)
3. Voltage across a capacitor is under 170 volts. (Due to improper input voltage connections.)
4. Internal component damage.

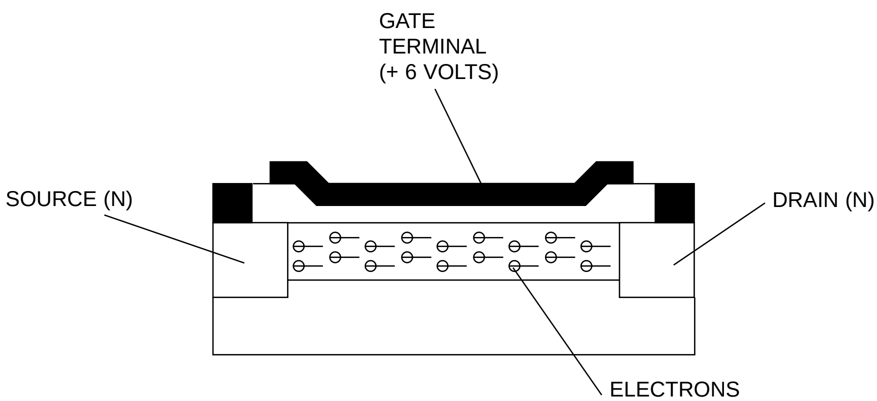
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FIELD EFFECT TRANSISTOR (FET) OPERATION

FIGURE E.10 – FIELD EFFECT TRANSISTOR OPERATION



A. PASSIVE



B. ACTIVE

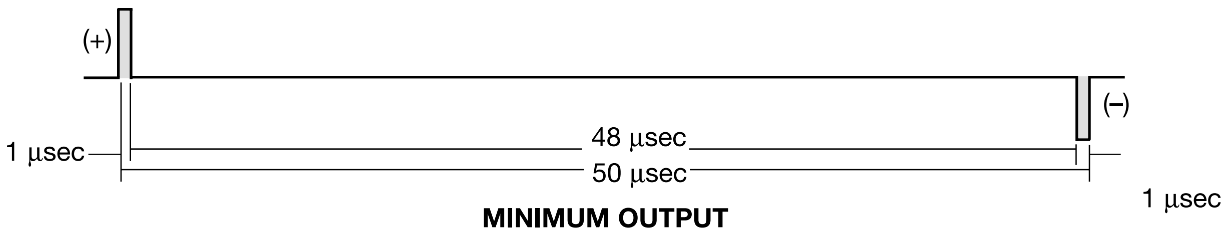
An FET is a type of transistor. FETs are semiconductors well suited for high-frequency switching.

Drawing A above shows an FET in a passive mode. There is no gate signal (zero volts) from the source and, therefore, no current flow. The drain terminal of the FET may be connected to a voltage supply. But since there is no conduction, the circuit will not supply current to downstream components connected to the source. The circuit is turned off like a light switch in the OFF position.

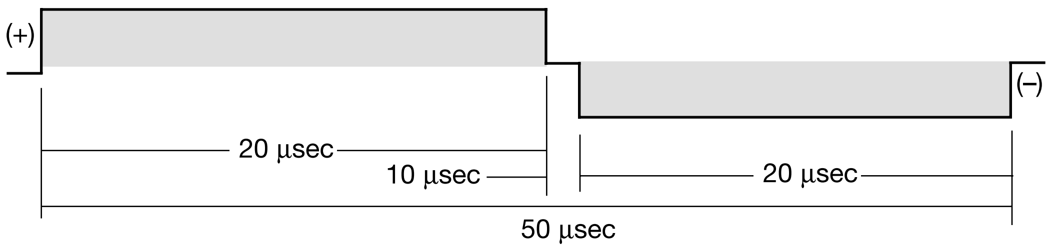
Drawing B above shows the FET in an active mode. When the gate signal, a positive DC voltage relative to the source, is applied to the gate terminal of the FET, it can't conduct current. A voltage supply connected to the drain terminal will allow the FET to conduct and henceforth supply current to downstream components. Current will flow through the conducting FET to downstream components as long as the gate signal is present. This is similar to turning on a light switch.

PULSE WIDTH MODULATION

FIGURE E.11 – TYPICAL FET OUTPUTS



MINIMUM OUTPUT



MAXIMUM OUTPUT

The term PULSE WIDTH MODULATION is used to describe how much time is devoted to conduction in the positive and negative portions of the cycle. Changing the pulse width is known as MODULATION. Pulse Width Modulation (PWM) is the varying of the pulse width over the allowed range of a cycle to affect the output of the machine.

MINIMUM OUTPUT

By controlling the duration of the gate signal, the FET is turned on and off for different durations during a cycle. The top drawing above shows the minimum output signal possible over a 50-microsecond time period.

The positive portion of the signal represents one FET group[1] conducting for 1 microsecond. The negative portion is the other FET group[1]. The dwell time (off time) is 48 microseconds (both FET groups off). Since only 2 microseconds of the 50-microsecond time period is devoted to conducting, the output power is minimized.

MAXIMUM OUTPUT

By holding the gate signals on for 20 microseconds each and allowing only 10 microseconds of dwell time (off time) during the 50-microsecond cycle, the output is maximized. The darkened area under the top curve can be compared to the area under the bottom curve. The more dark area under the curve, the more power is present.

[1]A FET group consists of the sets of FET modules grouped onto one switch board.

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HOW TO USE TROUBLESHOOTING GUIDE

⚠ WARNING

Service and repair should be performed by only Lincoln Electric Factory Trained Personnel. Unauthorized repairs performed on this equipment may result in danger to the technician and machine operator and will invalidate your factory warranty. For your safety and to avoid Electrical Shock, please observe all safety notes and precautions detailed throughout this manual.

This Troubleshooting Guide is provided to help you locate and repair possible machine malfunctions. Simply follow the three-step procedure listed below.

Step 1. LOCATE PROBLEM (SYMPTOM). Look under the column labeled "PROBLEM (SYMPTOMS). This column describes possible symptoms that the machine may exhibit. Find the listing that best describes the symptom that the machine is exhibiting. Symptoms are grouped into three main categories: Output Problems, Function Problems, and Welding Problems.

Step 2. PERFORM EXTERNAL TESTS. The second column, labeled "POSSIBLE AREAS OF MISADJUSTMENT(S)," lists the obvious external possibilities that may contribute to the machine symptom. Perform these tests/checks in the order listed. In general, these tests can be conducted without removing the case wrap-around cover.

Step 3. PERFORM COMPONENT TESTS. The last column, labeled "Recommended Course of Action," lists the most likely components that may have failed in your machine. It also specifies the appropriate test procedure to verify that the subject component is either good or bad. If there are a number of possible components, check the components in the order listed to eliminate one possibility at a time until you locate the cause of your problem.

All of the referenced test procedures referred to in the Troubleshooting Guide are described in detail at the end of this chapter. Refer to the Troubleshooting and Repair Table of Contents to locate each specific Test Procedure. All of the referred to test points, components, terminal strips, etc., can be found on the referenced electrical wiring diagrams and schematics. Refer to the Electrical Diagrams Section Table of Contents to locate the appropriate diagram.

⚠ CAUTION

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-800-833-9353.

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PC BOARD TROUBLESHOOTING PROCEDURES AND REPLACEMENT

⚠ WARNING

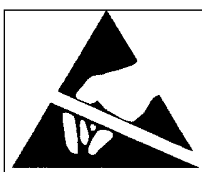


ELECTRIC SHOCK can kill.

Have an electrician install and service this equipment. Turn the machine OFF before working on equipment. Do not touch electrically hot parts.

Sometimes machine failures appear to be due to PC board failures. These problems can sometimes be traced to poor electrical connections. To avoid problems when troubleshooting and replacing PC boards, please use the following procedure:

1. Determine to the best of your technical ability that the PC board is the most likely component causing the failure symptom.
2. Check for loose connections at the PC board to assure that the PC board is properly connected.
3. If the problem persists, replace the suspect PC board using standard practices to avoid static electrical damage and electrical shock. Read the warning inside the static resistant bag and perform the following procedures.



ATTENTION
Static-Sensitive Devices
Handle only at Static-Safe Workstations

Reusable Container
Do Not Destroy

PC Board can be damaged by static electricity.

- Remove your body's static charge before opening the static-shielding bag. Wear an anti-static wrist strap. For safety, use a 1 Meg ohm resistive cord connected to a grounded part of the equipment frame.
- If you don't have a wrist strap, touch an unpainted, grounded, part of the equipment frame. Keep touching the frame to prevent static build-up. Be sure not to touch any electrically live parts at the same time.

- Tools which come in contact with the PC Board must be either conductive, anti-static or static-dissipative.
- Remove the PC Board from the static-shielding bag and place it directly into the equipment. Don't set the PC Board on or near paper, plastic or cloth which could have a static charge. If the PC Board can't be installed immediately, put it back in the static-shielding bag.
- If the PC Board uses protective shorting jumpers, don't remove them until installation is complete.
- If you return a PC Board to The Lincoln Electric Company for credit, it must be in the static-shielding bag. This will prevent further damage and allow proper failure analysis.

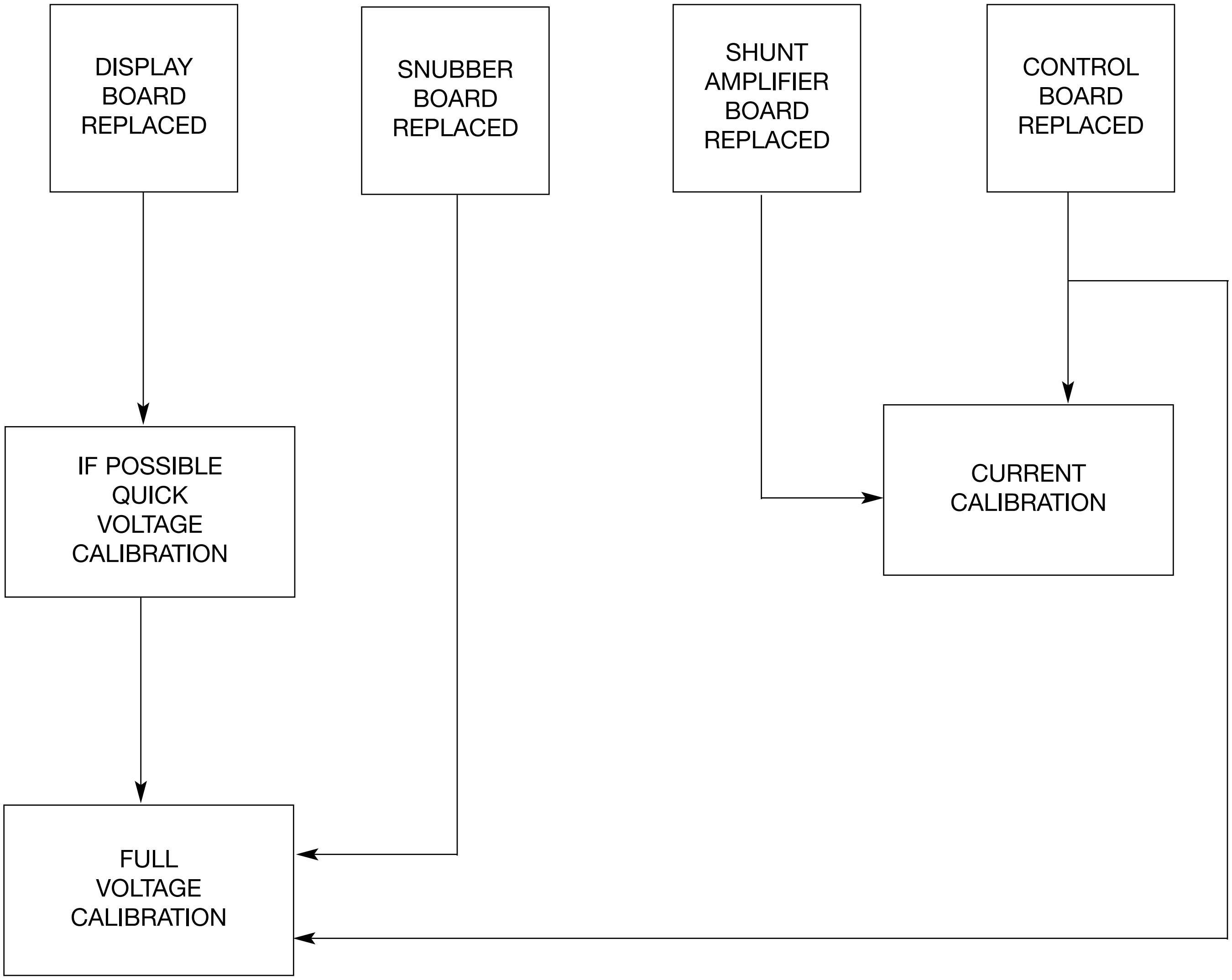
4. Perform any necessary PC Board calibration procedures. See the flow chart on the next page.
5. Test the machine to determine if the failure symptom has been corrected by the replacement PC board.

NOTE: Allow the machine to heat up so that all electrical components can reach their operating temperature.

6. Remove the replacement PC board and substitute it with the original PC board to recreate the original problem. Recalibrate if required.
   a. If the original problem does not reappear by substituting the original board, then the PC board was not the problem. Continue to look for bad connections in the control wiring harness, junction blocks, and terminal strips.
   b. If the original problem is recreated by the substitution of the original board, then the PC board was the problem. Reinstall the replacement PC board, recalibrate if required, and test the machine.
7. Always indicate that this procedure was followed when warranty reports are to be submitted.

NOTE: Following this procedure and write on the warranty report, "INSTALLED AND SWITCHED PC BOARDS TO VERIFY PROBLEM," will help avoid denial of legitimate PC board warranty claims.

PC BOARD REPLACEMENT CALIBRATION REQUIREMENTS



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Observe Safety Guidelines detailed in the beginning of this manual.

PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
OUTPUT PROBLEMS		
Major physical or electrical damage is evident when the sheet metal cover(s) are removed.	1. Contact your local authorized Lincoln Electric Field Service Facility for technical assistance.	
Machine is dead – no output – no fans – no displays.	1. Check the main input fuses. If open, replace. 2. Make certain that the input power switch (S1) is in the "ON" position. 3. Check for proper input voltage – must match the rating on the machine nameplate. 4. Make certain the reconnect panel is configured properly for the applied voltage. 5. Check fuse (F1) in the reconnect panel. If faulty, replace with 5-amp slow-blow fuse.	1. If fuse (F1) quickly fails, perform the ***Auxiliary Transformer Primary Wiring Harness Test.*** 2. If fuse (F1) does not fail, perform the ***Auxiliary Transformer Test #1.***

⚠ CAUTION

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-800-833-9353.

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Observe Safety Guidelines detailed in the beginning of this manual.

PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
	OUTPUT PROBLEMS	
Machine has no output – fans are running – display is on – a "clicking" sound is heard coming from the machine.	1. Turn power OFF immediately. 2. Check for proper input voltage (per machine nameplate). 3. Make certain the reconnect panel is configured properly for the applied voltage.	1. Perform the ***Auxiliary Transformer Test #1*** 2. Perform the ***Main Contactor Test.*** 3. Perform the ***Reconnect Switch Test #1.*** 4. Perform the ***Reconnect Switch Test #2.*** 5. Perform the ***Input Rectifier Test.*** 6. Perform the ***Switch Board Test***. 7. Perform the ***Snubber and Bleeder Resistor Test.*** 8. The protection board may be faulty. Replace. 9. The input filter capacitors may be faulty. Replace.

CAUTION

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-800-833-9353.

TROUBLESHOOTING GUIDE

Observe Safety Guidelines detailed in the beginning of this manual.

PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
OUTPUT PROBLEMS		
Fans run slow or intermittently – display is very dim – no weld output.	1. Make certain the reconnect panel and fuse (F1) jumper "A" is configured properly for the input voltage being applied.	1. Perform the ***Auxiliary Transformer Test #1.***
Machine has no output – no display – fans run – circuit breaker (5 amp) repeatedly trips.	1. Make sure that not more than 5 amps of auxiliary power are being drawn. 2. Remove the wire feeder control cable from the Power Wave. If the symptom disappears, the wire feeder or control cable is faulty.	1. The circuit breaker (5 amp) may be faulty. Test or replace. 2. Perform the ***Auxiliary Transformer #1 Secondary and Wiring Harness Test.***

⚠ CAUTION

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TROUBLESHOOTING GUIDE

Observe Safety Guidelines
detailed in the beginning of this manual.

PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
OUTPUT PROBLEMS		
Machine has no output – no fans – no display. Main input fuses are open indicating excessive input current draw.	1. Check for proper input voltage connections. 2. Make certain the reconnect panel is configured properly for the applied voltage. 3. Replace the input fuses with proper size and ratings.	1. Perform the ***Input Power and Wiring Harness Test.*** 2. Perform the ***Input Rectifier Test.*** 3. Perform the ***Reconnect Switch Test #1.*** 4. Perform the ***Switch Board Test.*** 5. Perform the ***Snubber and Bleeder Resistor Test.***
Machine has no output – no display – fans run.	1. Check circuit breaker (5 amp) located on the front panel. Reset if necessary.	1. Perform the ***Auxiliary Transformer Test #1.*** 2. Perform the ***Internal and Auxiliary Supply Voltage Test.***
Machine has no output – fans run - Display flashes On and Off repeatedly.	1. Check for loose or faulty connections at the Power P.C. Board. See Wiring Diagram.	1. Replace the Power P.C. Board.

⚠ CAUTION

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TROUBLESHOOTING GUIDE

Observe Safety Guidelines detailed in the beginning of this manual.

PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
OUTPUT PROBLEMS		
Circuit breaker (5 amp) trips when gun trigger is pulled – fans run.	1. Make sure that not more than 5 amps of auxiliary power are being used. 2. Remove the wire feeder's control cable(s) from the Power Wave. If the symptoms disappear, replace the wire feeder and cables with known good equipment. If the problem is solved, the wire feeder or control cable is faulty.	1. The 5 amp circuit breaker may be faulty. Test or replace. 2. Perform the ***Trigger Circuit and Wiring Harness Test.***
The machine intermittently loses output. The wire feeder still feeds wire.	1. If after a few seconds the contactor "pulls" back in, then check for high input line voltage.	1. Perform the ***Static Capacitor Balance Test.*** 2. Perform the ***Welding Feedback Test.*** 3. The control board may be faulty. Replace. 4. The shunt board assembly may be faulty. Replace. 5. Perform the ***Switch Board Test.***

⚠ CAUTION

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TROUBLESHOOTING GUIDE

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detailed in the beginning of this manual.

PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
OUTPUT PROBLEMS		
Machine has no welding output – fans run – display is on.	1. Make sure that the machine was powered up with a properly installed overlay. Without an overlay installed in the Power Wave, or an invalid overlay installed, the machine will not have welding output. 2. Check to see if the Limits or Setup overlay is installed on the front panel. These two overlays cannot be used for welding. 3. Check for proper input voltage per machine nameplate. 4. Make certain the reconnect panel is configured properly. 5. Check to see that when the trigger is pulled on the wire feeder the wire feeder's voltage display changes to indicate arc voltage. If this does not happen, the feeder or control cable may be faulty. 6. Check wire feeder control cable for loose or faulty connections. 7. If the machine is connected for 380VAC or higher and has not been used for a long period of time, the capacitors may require "conditioning." Let the Power Wave run at an idle state for 30 minutes.	1. Perform the ***Wire Feeder Trigger Circuit Test (#1 or #2)*** for the appropriate wire feeder receptacle (amphenol). 2. If a K941-1 Remote Control Kit is attached to the Power Wave, then perform the ***K941-1 Remote Control Kit Trigger Circuit Test.*** 3. Perform the ***Reconnect Switch Test #1.*** 4. Perform the ***Output Rectifier Diodes Test.*** 5. Perform the ***Switch Board Test.*** 6. Perform the ***Snubber and Bleeder Resistor Test.*** 7. Perform the ***Static Capacitor Balance Test.*** 8. Perform the ***Dynamic Capacitor Balance Test.***

⚠ CAUTION

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-800-833-9353.

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Observe Safety Guidelines detailed in the beginning of this manual.

PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
OUTPUT PROBLEMS		
Machine regularly overheats-yellow light (LED) on the front panel glows, indicating a thermal overload. The display is on.	1. Welding application may exceed recommended duty cycle. 2. Dirt and dust may have clogged the cooling channels inside the machine. Refer to the Maintenance Section of this manual. 3. Air intake and exhaust louvers may be blocked due to inadequate clearance around machine. 4. Make sure both fans are functioning correctly.	1. One of the thermostats located on the output rectifier or FET heat sink may be faulty. Test or replace.
Machine does not appear to overheat, but yellow light turns on and off intermittently. Output is disabled whenever yellow light is on.	NONE	1. Check thermostats on output rectifier and switch board #1. These thermostats are normally closed. 2. Check leads from thermal switches to molex plug J23 on the control board for loose or faulty connections. 3. The control board may be faulty. Replace, and perform voltage calibration and current calibration procedures.

⚠ CAUTION

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PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
FUNCTION PROBLEMS		
The voltage and or wire feed speed will not adjust to user satisfaction.	1. Certain limits may have been imposed on the welding parameters. Refer to the Limits Overlay section of this manual.	NONE
The voltage and or wire feed speed can be adjusted on the wire feeder, but the changes are not shown on the Power Wave display.	1. When the Limits Overlay or the Setup Overlay is installed in the Power Wave, the machine and wire feeder displays do not match. These overlays cannot be used for welding. 2. If two wire feeders are connected to the Power Wave, only one of the feeder's settings can be displayed on the Power Wave at one tme. Pull the trigger of the wire feeder whose settings you want displayed on the Power Wave.	1. Try the other wire feeder receptacle. If the problem is solved, the initial receptacle or associated wiring is faulty. 2. If the problem persists with both wire feeder receptacles, check or replace the wire feeder and control cable. 3. If the wire feeder and control cable are OK, then perform the ***Serial Loop Wiring Harness Test.*** 4. The display board may be faulty. Replace and perform voltage calibration. 5. The control board may be faulty. Replace and perform voltage calibration and current calibration.
The Dual Procedure overlay is installed, and the user cannot change from procedure "A" to procedure "B" or vice versa.	1. Check for proper installation of the Dual Procedure overlay. 2. Check the Dual Procedure Gun Trigger or separate dual procedure switch.	1. Perform the ***Serial Loop Wiring Harness Test.***

CAUTION

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-800-833-9353.

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PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
FUNCTION PROBLEMS		
The display cannot be seen clearly or cannot be seen at all.	1. Adjust the viewing angle of the display. Follow the instructions provided in the ***Operation*** Section of this manual. (Look under the "LCD DISPLAY ADJUSTMENTS" in the "CONTROLS AND SETTINGS" sub-section of the ***Operation*** Section.)	1. Perform the ***LCD Display Test.***
Machine does not respond to keys being pressed, or the machine has improper displays.	1. Each time an overlay is changed, make certain that the machine is powered-up with the new overlay in place. 2. Make certain that the correct overlay ID number is displayed on power-up. Refer to the ***Operation*** Section of this manual for the overlay description. 3. In some cases, some of the keys on the overlay may be locked out. Refer to the ***Operation*** Section of this manual for the overlay descriptions.	1. Using the test and calibration overlay L9660-255, perform the keyboard/LED test. See overlay. 2. Perform the ***Serial Loop Wiring Harness Test.*** 3. Replace the control board and perform voltage calibration and current calibration. 4. Replace the display board and perform voltage calibration. 5. Replace the power board.

⚠ CAUTION

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-800-833-9353.

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Observe Safety Guidelines detailed in the beginning of this manual.

PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
FUNCTION PROBLEMS		
Machine display reads "Error Invalid Overlay," or it displays an invalid ID number on power-up.	1. Make certain the overlay is installed properly. 2. Inspect the infrared sensors on the front panel. If they are dirty, blow them out with low pressure air and clean with a soft cloth. 3. Inspect for damage to the Bar Code(s) (black squares) on the back of the overlay. Also check for dirt build-up on back of overlay. Wipe off with a soft rag.	1. Perform the ***Sensor Calibration Test.***
Machine displays "ERROR: S.L. NOT INITIALIZED" on power-up.	1. Contact your local Lincoln Authorized Field Service Facility for technical assistance.	1. Perform the ***Serial Loop Wiring Harness Test.*** 2. The control board may be faulty. Replace and perform voltage calibration and current calibration. 3. The display board may be faulty. Replace and perform voltage calibration. 4. The power board may be faulty. Replace.

CAUTION

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-800-833-9353.

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PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
FUNCTION PROBLEMS		
The Beeper (Piezoelectric Buzzer) cannot be heard – machine operating normally.	1. Background noise may be too loud for user to hear beeper.	1. Perform the ***Piezoelectric Buzzer Test.*** 2. The display board may be faulty. Replace and perform voltage calibration.
The welding parameters that were saved in memory are different when recalled.	1. Make certain that a remote control unit is NOT connected. When a remote control unit is used, the weld parameters are set by the remote control potentiometers.	1. Check the continuity of wire #445 (8J44 to 8J16). 2. The power board may be faulty. Replace. 3. The display board may be faulty. Replace.
The water cooler does not turn on.	1. Make sure that the water cooler has been installed and also enabled. Refer to the Setup Overlay description in the ***Operation*** Section of the manual. 2. If the water cooler is enabled but there is insufficient flow rate in the water cooler hose, the Power Wave will beep loudly, and the water cooler will shut down. Prime the water cooler. Refer to the Setup Overlay description in the ***Operation*** Section of this manual. 3. The coolers circuit breaker may have tripped. Reset if necessary	1. Perform the ***Auxiliary Transformer #2 Test.*** 2. Check the continuity of leads #453, 454, 455 & 456. From plug J3 to J11. See wiring diagram. 3. The display board may be faulty. Replace. 4. The water cooler may be faulty.

⚠ CAUTION

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-800-833-9353.

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PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
FUNCTION PROBLEMS		
The machine beeps without the keys being pressed.	If the water cooler is enabled and the flow switch inside the water cooler opens (due to inadequate coolant flow rate), the machine indicates this by beeping. This happens regardless of the overlay placed on the machine. In this case, do the following. 1. Turn the machine off and on a couple of times and see if the beeping continues. If the flow rate dropped momentarily, then turning the machine off and on eliminates the beeping. A momentary drop in flow rate could be due to a temporary restriction in the water cooler hose. 2. Check the water cooler and accessory hoses for kinks, internal obstructions or blockage, or ruptures. If such problems were found then correct them. Turn the machine Off and On to check if the beeping has been eliminated. 3. Check the water cooler fluid level. Low coolant level could cause the flow rate to drop. 4. Prime the water cooler. Refer to the ***Setup Overlay section*** of this manual for instructions.	1. Perform the ***Auxiliary Transformer #2 Test.*** 2. The water cooler may be defective. Replace. 3. Check the continuity of lead #453, 454, 455 & 456 from plug J3 to J11. See wiring diagram. 4. The display board may be faulty. Replace.

⚠ CAUTION

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-800-833-9353.

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PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
FUNCTION PROBLEMS		
Foreign characters are shown on the Power Wave display.	Contact your local Lincoln Authorized Field Service Facility.	1. Make sure molex plug J19 is plugged into the Display board securely and the pins are secure in the plug body. 2. The display board may be faulty. Replace and perform voltage calibration.

CAUTION

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-800-833-9353.

TROUBLESHOOTING GUIDE

Observe Safety Guidelines detailed in the beginning of this manual.

PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
FUNCTION PROBLEMS		
The control knob on the Remote Control Kit (K941-1) does not change the preset current on the Power Wave display.	1. Make sure that a stick welding procedure is selected on the Power Wave. 2. Make certain that the (K941-1) remote control is securely plugged into the Power Wave 6 pin amphenol receptacle.	1. Perform the ***(K941-1) Remote Control Kit Test*** or install a new K941-1. 2. Perform the ***Internal Remote Control Test.***

⚠ CAUTION

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-800-833-9353.

TROUBLESHOOTING GUIDE

Observe Safety Guidelines detailed in the beginning of this manual.

PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
WELDING PROBLEMS		
Machine loses output while welding. Fans and display are functioning properly.	1. Check the yellow High Temperature light on the front-panel. If the light is "ON," then refer to the Output Problems section in this table relating to this condition. 2. Check for proper input voltages (per machine nameplate). 3. Check for balanced three-phase input supply voltages. 4. Check electrode and work cables for loose or poor connections.	1. Perform the ***Welding Feedback Test.*** 2. Perform the ***Switch Board Test.*** 3. Perform the ***Snubber and Bleeder Resistor Test.*** 4. Perform the ***Static Capacitor Balance Test.*** 5. Perform the ***Dynamic Capacitor Test.*** 6. Perform the appropriate ***Wire Feeder Trigger Circuit Test.*** If a K941-1 Remote Control Kit is used, perform the ***K941-1 Remote Control Kit Trigger Circuit Test.***

⚠ CAUTION

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-800-833-9353.

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TROUBLESHOOTING GUIDE

Observe Safety Guidelines
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PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
WELDING PROBLEMS		
For no apparent reason the weld characteristics have changed.	1. Check for proper wire feed speed setting. In the MIG/MAG and FCAW Modes, check for proper voltage settings. In the MIG/MAG Pulse Modes, check the arc length trim setting. These controls are on the wire feeder. In the Stick Mode, check for proper preset current setting. 2. Check for proper shielding gas and gas flow. 3. Check for loose or faulty welding cables.	1. If zero arc voltage is displayed while welding, the voltage sense leads may be broken. Check the following molex plugs and associated wiring for loose or faulty connections: J60, J62 on the snubber board J20 on the control board 2. Perform the ***Welding Feedback Test.*** 3. The control board may be faulty. Replace and perform voltage calibration and current calibration.
The arc is "too hot," and cannot be adjusted.	1. Perform the full voltage calibration.	1. Check plugs J60, J62 and J20 for loose or faulty connections. See Wiring Diagram. 2. The snubber board may be faulty. Replace and perform full voltage calibration. 3. The control board may be faulty. Replace and perform voltage calibration and current calibration.

⚠ CAUTION

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-800-833-9353.

TROUBLESHOOTING GUIDE

Observe Safety Guidelines detailed in the beginning of this manual.

PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
WELDING PROBLEMS		
Machine often “noodle welds” with a particular procedure.	1. The machine may be trying to deliver too much power. When the average output current exceeds a maximum limit, the peak current is drastically cut back. Lower the welding parameter settings and/or increase the stickout length to eliminate this problem. Power Wave 450 – When the average output current exceeds 540 amps, the peak output current is folded back to 100 amps.	If problem occurs all the time - change the control board.
Erratic output or greater than 6 amps reading on display with no output.	None	Replace shunt and lead assembly.

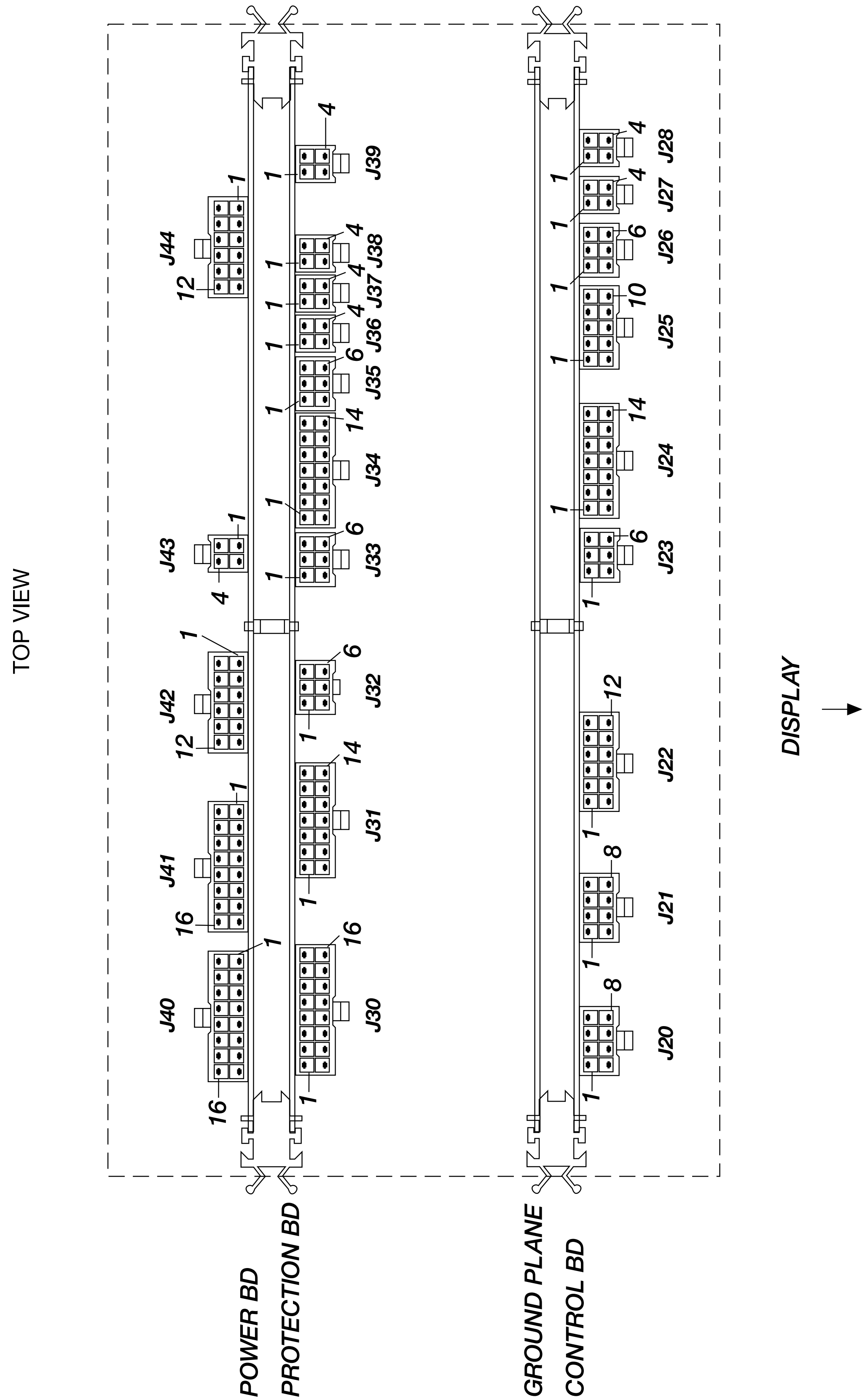
⚠ CAUTION

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-800-833-9353.

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PC BOARD CONNECTOR LOCATIONS

FIGURE F.1 – PC BOARD CONNECTOR LOCATIONS



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CAPACITOR DISCHARGE PROCEDURE

⚠ WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-800-833-9353 (WELD).

PURPOSE FOR THE PROCEDURE

This procedure will drain off any charge stored in the four large capacitors that are part of the FET or IGBT switch board assembly. This procedure MUST be performed, as a safety precaution, before conducting any test or repair procedure that requires you to touch internal components of the machine.

MATERIALS NEEDED

Volt/Ohmmeter (Multimeter)
5/16" Nut driver
3/8" Nut driver
Insulated gloves
Jumper wire with insulated leads and needle-nose ends
High wattage resistor - 25 to 1000 ohms, 25 watts minimum
Piece of glastic board or similar insulating materials on which to secure the resistor

This procedure takes approximately 25 minutes to perform.

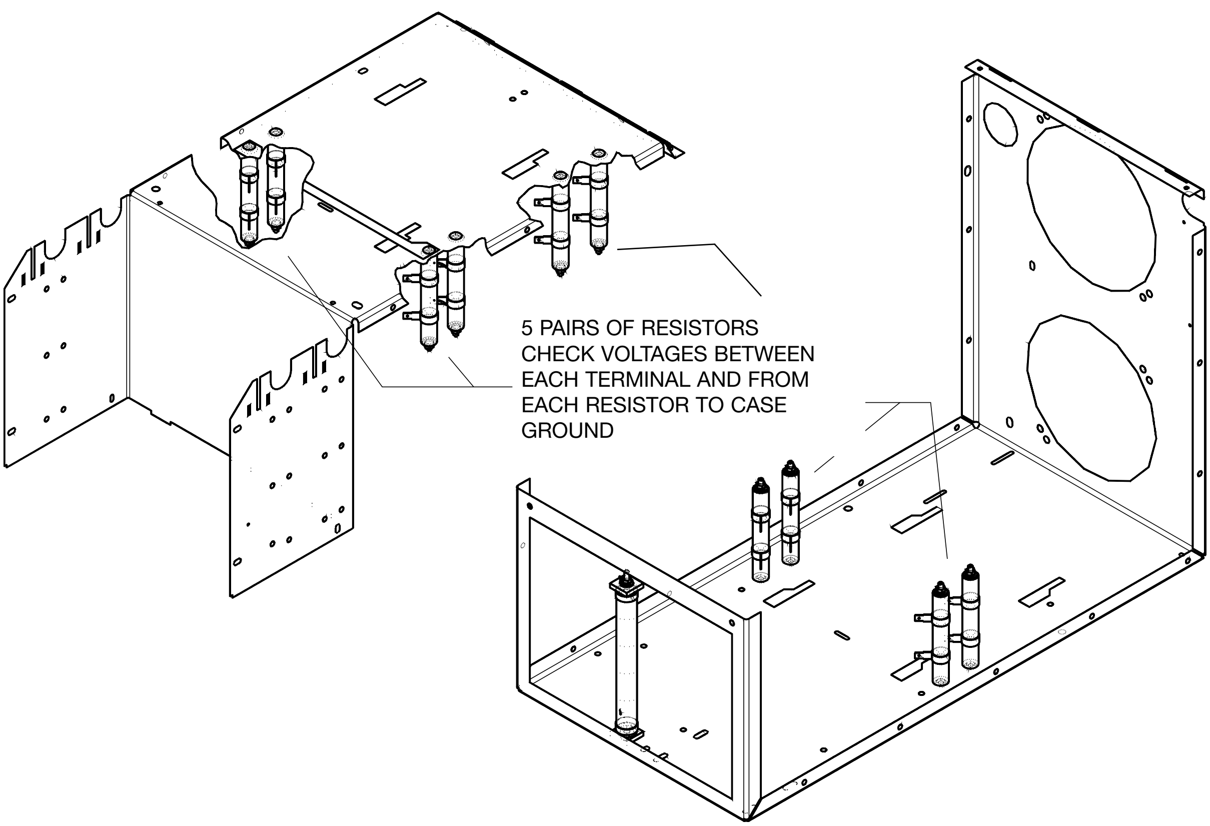
Return to Section TOC
Return to Master TOC

CAPACITOR DISCHARGE PROCEDURE *(continued)*

TEST PROCEDURE

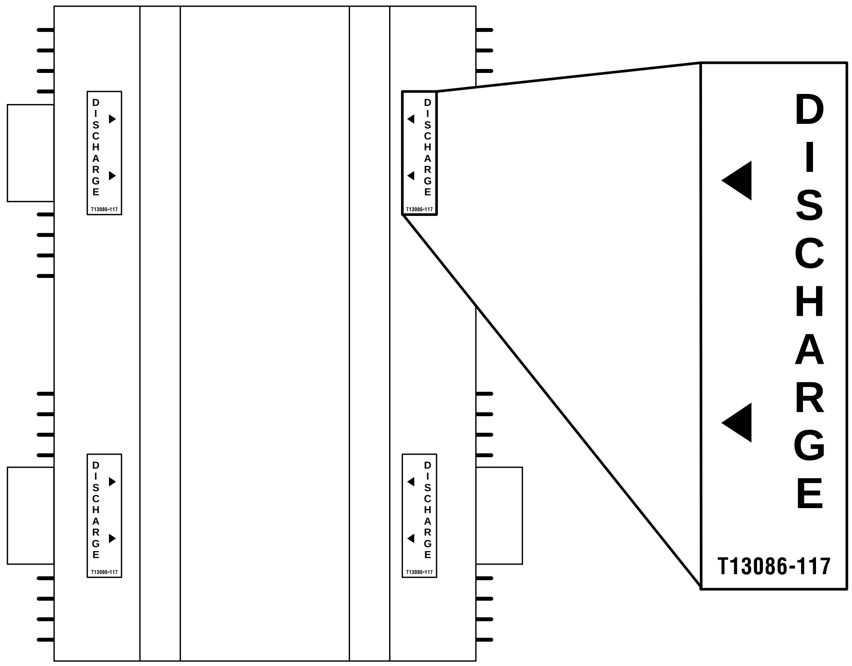
1. Remove main input supply power to the machine.
2. With the 3/8" nut driver, remove the screws that hold the handle to the machine.
3. Remove the rubber gasket (cover seal) from the lift bail.
4. With the 5/16" nut driver, remove the sheet metal screws from the case top.
5. With the 5/16" nut driver, remove the screws holding the right and left case sides. Remove the case sides by lifting up and out.
6. Obtain a high resistance and high wattage resistor (25 - 1000 ohms, 25 watts minimum). This resistor is not supplied with the machine. Secure this resistor to a piece of insulating material such as a glastic board. See ***Figure F.4.*** NEVER USE A SHORTING STRAP FOR THIS PROCEDURE.
7. Locate the two sets of two resistors on the left side of the machine and three sets of two resistors on the right side of the machine. See Figure F.2. Do not touch the resistors or any other internal machine component. Using a DC voltmeter, check for any DC voltage that may be present across the terminals of each resistor and from each resistor to case ground (20 measurements in all). If a voltage is present, be careful not to touch these resistors.
8. Locate terminals #9 and #12 on the switch boards. They can be identified by the “Discharge” labels, which are located on each of the four switch boards. See ***Figure F.3.***

FIGURE F.2 – RESISTOR LOCATIONS



CAPACITOR DISCHARGE PROCEDURE *(continued)*

FIGURE F.3 – DISCHARGE LABEL



WARNING



ELECTRIC SHOCK can kill.

Proceed with caution. Be careful not to touch any internal machine components during the discharge procedure.

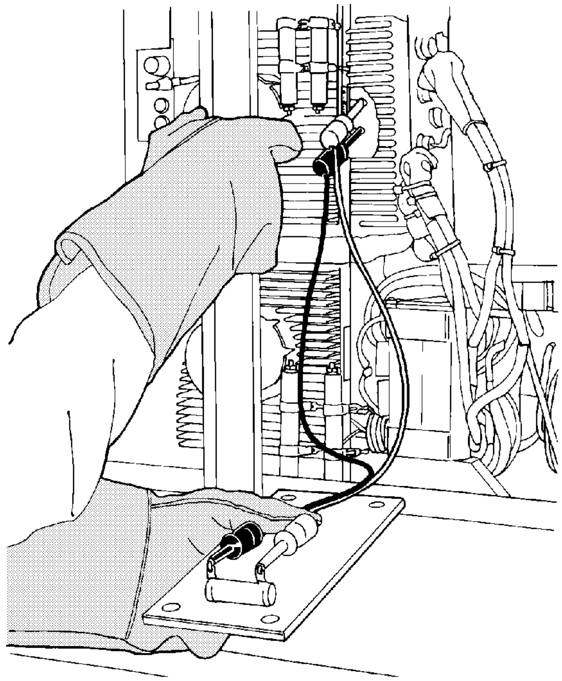
9. Using the insulated, needle nose type jumper leads and insulated gloves, connect one jumper lead to one end of the resistor obtained in step 6. Connect the other jumper lead to the other end of the resistor.

10. Carefully connect the needle nose end of one of the jumper leads to terminal #9. See ***Figure F.5.*** Connect the needle nose end of the other jumper lead to terminal #12. Terminals #9 and #12 are indicated by the "Discharge" label. Leave the resistor connected for 10 seconds. DO NOT TOUCH TERMINALS, RESISTORS, OR ANY INTERNAL MACHINE COMPONENTS DURING THIS PROCEDURE!

Return to Section TOC Return to Master TOC
Return to Section TOC Return to Master TOC
Return to Section TOC Return to Master TOC
Return to Section TOC Return to Master TOC

CAPACITOR DISCHARGE PROCEDURE *(continued)*

FIGURE F.4 - RESISTOR WITH LEADS CONNECTED.



11. Check the voltage across terminals #9 and #12 with the DC voltmeter. Terminal #9 has positive polarity and terminal #12 has negative polarity. Voltage should be zero. If any voltage remains, repeat this capacitor discharge procedure.

12. Repeat discharge procedure steps 9, 10, and 11 for each of the other three switch boards of the FET or IGBT switch board assembly.

AUXILIARY TRANSFORMER TEST #1

⚠ WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-800-833-9353 (WELD).

TEST DESCRIPTION

This test will determine if the correct voltage is being applied to the primary of Auxiliary Transformer #1 and also if the correct voltages are being induced on the secondary windings of the transformer.

MATERIALS NEEDED

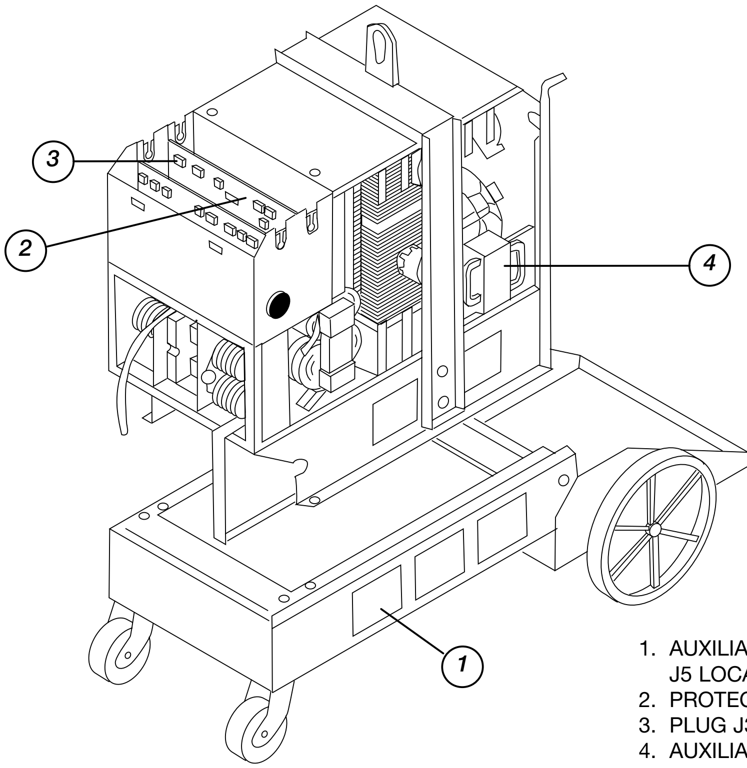
Volt/Ohmmeter (Multimeter)
5/16" Nut driver
3/8" Nut driver
Input and Auxiliary Circuit Wiring Diagram – Figure F.6.

This procedure takes approximately 35 minutes to perform.

Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC

AUXILIARY TRANSFORMER TEST #1 *(continued)*

FIGURE F.5 - TRANSFORMER T1 AND T2 LOCATION



1. AUXILIARY TRANSFORMER T1, PLUG J5 LOCATED IN BASE
2. PROTECTION BOARD
3. PLUG J30
4. AUXILIARY TRANSFORMER T1

TEST PROCEDURE

1. Remove main input supply power to the machine.
2. With the 3/8" nut driver, remove the 4 screws that hold the handle to the machine.
3. Remove the rubber gasket (cover seal) from the lift bail.
4. With the 5/16" nut driver, remove the sheet metal screws from the case top.
5. With the 5/16" nut driver, remove the screws holding the right and left case sides. Remove the case sides by lifting up and out.
6. Perform the ***Capacitor Discharge Procedure*** described earlier in this section of the manual.

⚠ WARNING



Before continuing with the test procedure, perform the capacitor discharge procedure to avoid electric shock.

7. After you have completed the capacitor discharge procedure for all four switch boards, remove the PC board cover. Use the 5/16" nut driver.
8. Remove plug J5 from the T2 transformer located in the machine base assembly. This is a 6-pin molex plug with 5 wires; see Figure F. 5 for location. T2 is connected in parallel with T1. Leaving the two transformers connected in parallel for the test might result in incorrect readings; therefore plug J5 should be disconnected.
9. Remove plug J30 from the protection board. See ***Figure F.1*** for location of the board and plug J30.
10. Remove the 5 leads (3 heavy and 2 small) T1, T2, T3 from main input contactor CR1. This is a safety precaution. It prevents high voltage from being put on the machine during the test. Wrap tape around the lead ends to insulate them and prevent them from touching.

Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC

AUXILIARY TRANSFORMER TEST #1 *(continued)*

11. Remove plugs J32 and J33 from the protection board.

12. Turn the main input supply power to the machine back ON.

⚠ WARNING



ELECTRIC SHOCK can kill.

Proceed with caution. Be careful not to touch any internal machine components during the remainder of the test procedure.

---

13. Check for the correct AC voltage at plugs J32 and J33 as follows. (DO NOT CHECK THE VOLTAGE ON THE PROTECTION BOARD!)

    Test A: J33 - pin 1 (lead 32A) to J33 - pin 3 (lead 333) = 42 VAC

    Test B: J33-1 (32A) to J33-4 (334) = 24 VAC

    Test C: J32-1 (321) to J32-3 (323) = 24 VAC

    Test D: J33-1 (leads 32A) to J33-6 (lead 336) = 115VAC.

If the voltage checks are good, then Auxiliary Transformer #1 is good.

If Test C is good but Tests A and B are not correct, check the 5 amp circuit breaker (located on the front panel of the machine). See the Input and Auxiliary Circuit Wiring Diagram, ***Figure F.6.***

If all the secondary voltages are wrong or missing, check the associated wiring to the transformer primary. These voltages are most easily checked at the terminal strip. The correct voltages are as follows:

H1 to H2 = 200 - 208 VAC

H1 to H3 = 220 - 230 VAC

H1 to H4 = 380 - 415 VAC

H1 to H5 = 440 - 460 VAC

If these voltages are wrong or missing, check the associated wiring to the transformer primary. Check the leads at power switch S1. See the Input and Auxiliary Circuit Wiring Diagram, ***Figure F.6.***

If the correct voltages are applied to the primary and the secondary voltages are incorrect, the transformer may be faulty. Replace the transformer. Refer to the ***T1 Auxiliary Transformer Removal and Replacement procedure*** in this section of the manual.

14. After the test is completed and the problem successfully repaired, reconnect plugs J30, J32 and J33 to the protection board.

15. Reconnect plug J5 to the T2 transformer.

16. Reconnect the 5 leads to the main contactor CR1.

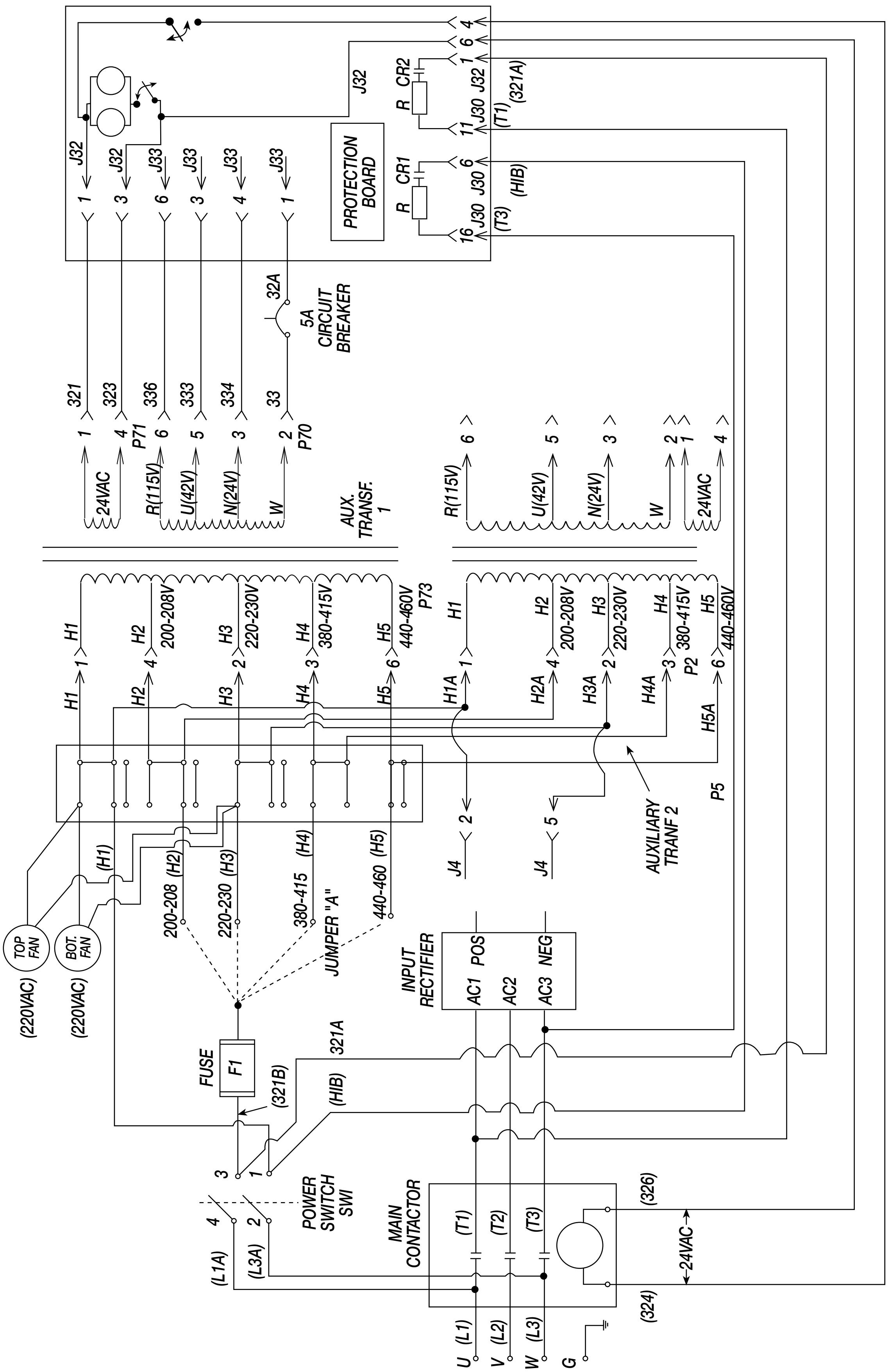
17. Install the PC board cover.

18. Install the machine case sides and top.

19. Install the handle and the lift bail rubber gasket.

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Return to Master TOC
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Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC

FIGURE F.6 – INPUT AND AUXILIARY CIRCUIT WIRING DIAGRAM



Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC

AUXILIARY TRANSFORMER TEST #2

⚠ WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-800-833-9353 (WELD).

TEST DESCRIPTION

This test will determine if the correct voltage is being applied to the primary of Auxiliary Transformer #2 and also if the correct voltages are being induced on the secondary windings of the transformer. Note: Transformer #2 is not present on all models.

MATERIALS NEEDED

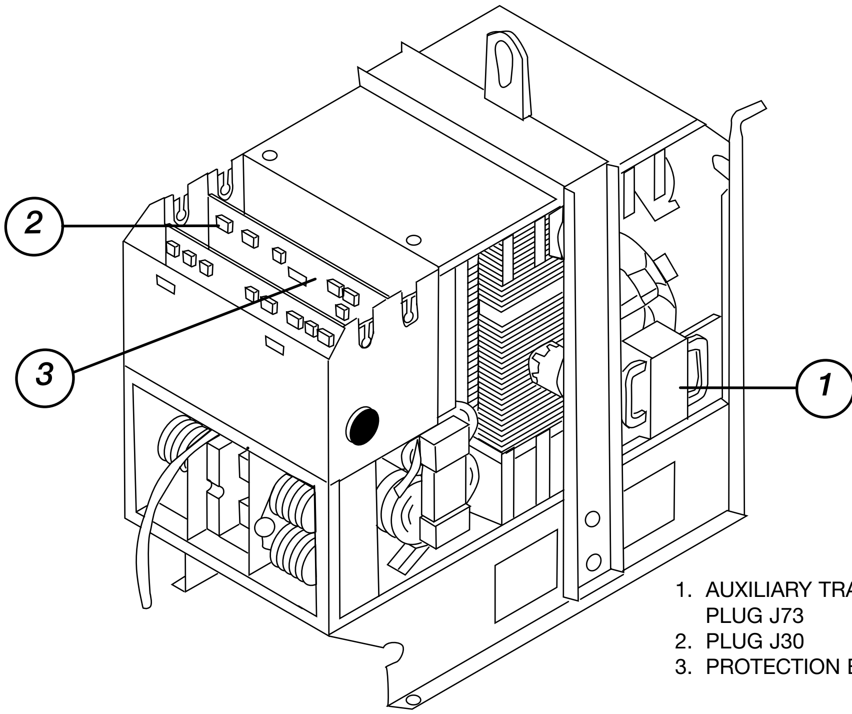
Volt/Ohmmeter (Multimeter)
5/16" Nut driver
3/8" Nut driver
Input and Auxiliary Circuit Wiring Diagram – Figure F.8

This procedure takes approximately 35 minutes to perform.

Return to Section TOC
Return to Master TOC

AUXILIARY TRANSFORMER TEST #2 *(continued)*

FIGURE F.7 - TRANSFORMER T1 AND T2 LOCATION



1. AUXILIARY TRANSFORMER T1 WITH PLUG J73
2. PLUG J30
3. PROTECTION BOARD

TEST PROCEDURE

1. Remove main input supply power to the machine.
2. With the 3/8" nut driver, remove the 4 screws that hold the handle to the machine.
3. Remove the rubber gasket (cover seal) from the lift bail.
4. With the 5/16" nut driver, remove the sheet metal screws from the case top.
5. With the 5/16" nut driver, remove the screws holding the right and left case sides. Remove the case sides by lifting up and out.
6. Perform the ***Capacitor Discharge Procedure*** described earlier in this section of the manual.

⚠ WARNING



Before continuing with the test procedure, perform the capacitor discharge procedure to avoid electric shock.

7. After you have completed the capacitor discharge procedure for all four switch boards, remove the PC board cover. Use the 5/16" nut driver.
8. Remove plug J73 from the T1 transformer. T2 is connected in parallel with T1. Leaving the two transformers connected in parallel for the test might result in incorrect readings; therefore plug J73 should be disconnected.
9. Remove plug J30 from the protection board. See ***Figure F.1*** for location of the board and plug J30.
10. Remove the 5 leads (3 heavy and 2 small) T1, T2, T3 from main input contactor CR1. This is a safety precaution. It prevents high voltage from being put on the machine during the test. Wrap tape around the lead ends to insulate them and prevent them from touching.

Return to Section TOC
Return to Master TOC

AUXILIARY TRANSFORMER TEST #2 *(continued)*

11. To conduct this test, you will be measuring the voltage between pin 2 and pin 5 of plug J4. The plug is located in the machine undercarriage and is somewhat difficult to reach. It is probably easiest to disconnect the plug and insert the probes of your voltmeter alongside pins 2 and 5 before turning on input power, which is the next step.
12. Turn the main input supply power to the machine back ON.

⚠ WARNING



ELECTRIC SHOCK can kill.

Proceed with caution. Be careful not to touch any internal machine components during the remainder of the test procedure.

---

13. Check for the correct AC voltage between plug J4 - pin 2 and J4 - pin 5. It should be 220 - 230 VAC.

If the voltage is correct, then Auxiliary Transformer #2 is good.

If the voltage is wrong or missing, check the associated wiring to the transformer primary. See the Input and Auxiliary Circuit Wiring Diagram, ***Figure F.8.*** These voltages are most easily checked at the terminal strip. The correct voltages are as follows:

H1A to H3A = 220 - 230 VAC

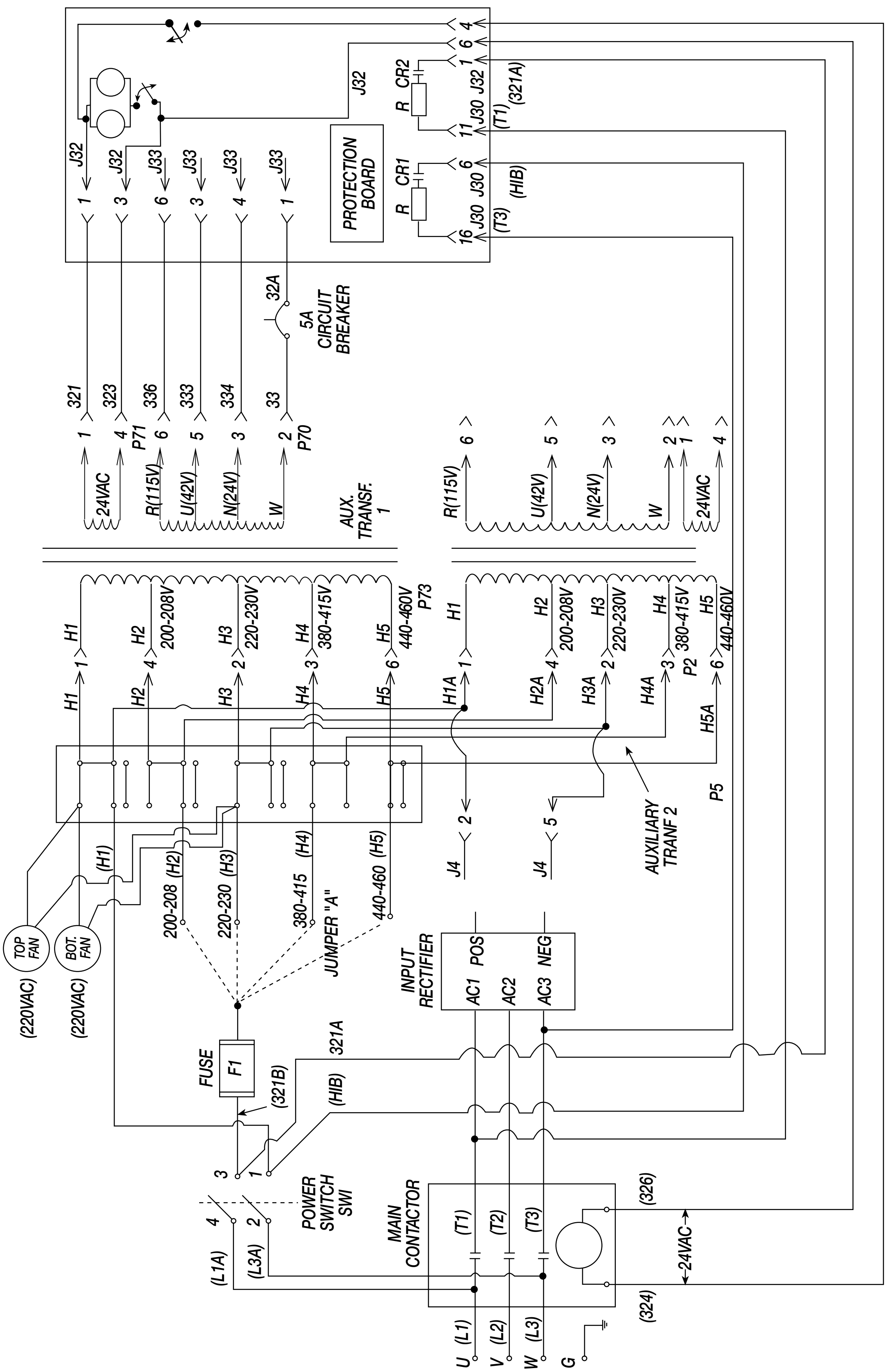
If this voltage is wrong or missing, check the associated wiring to the transformer primary.

If the correct voltage IS applied to the primary but the voltage at H1A to H3A is not correct, the transformer may be faulty. Replace the transformer. Refer to the ***T2 Auxiliary Transformer Removal and Replacement Procedure*** in this section of the manual.

14. After the test is completed and the problem successfully repaired, reconnect plug J30 to the protection board.
15. Reconnect plug J73 to the T1 transformer.
16. Reconnect the 5 leads to the main contactor CR1.
17. Install the PC board cover.
18. Install the machine case sides and top.
19. Install the handle and the lift bail rubber gasket.

Return to Section TOC
Return to Master TOC
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FIGURE F.8 – INPUT AND AUXILIARY CIRCUIT WIRING DIAGRAM



Return to Section TOC
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Return to Section TOC
Return to Master TOC

AUXILIARY TRANSFORMER PRIMARY WIRING HARNESS TEST

⚠ WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-800-833-9353 (WELD).

TEST DESCRIPTION

This test will determine if there are any short circuits or other problems in the circuit feeding the primary windings of the auxiliary transformers, which would cause the fuse (F1) on the reconnect panel to blow.

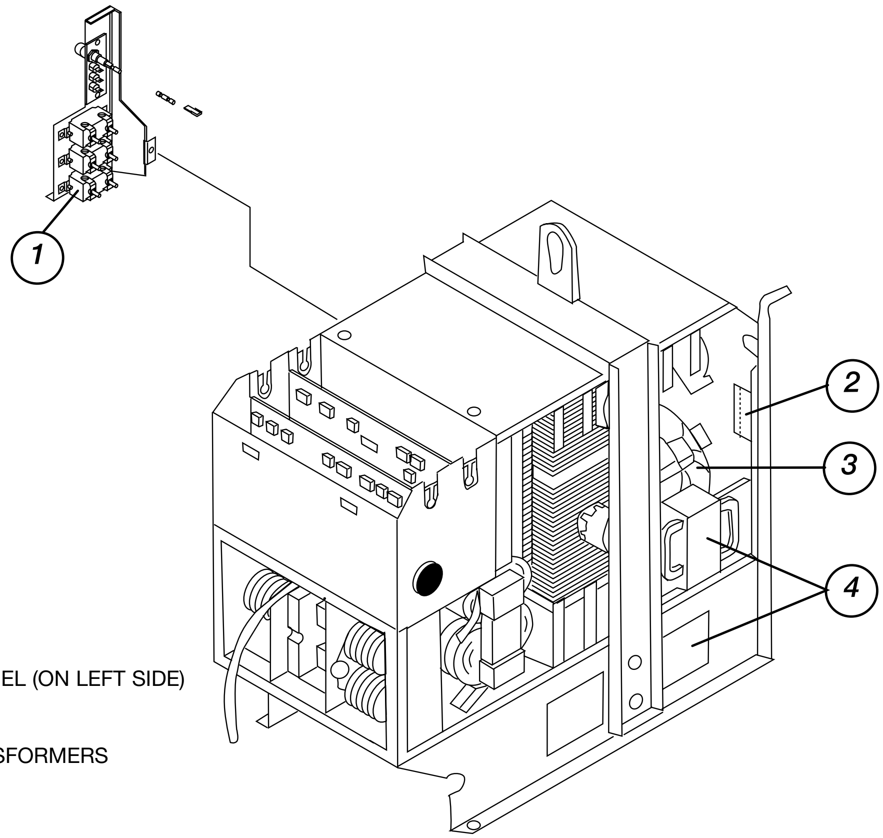
MATERIALS NEEDED

Volt/Ohmmeter (Multimeter)
5/16" Nut driver
3/8" Nut driver
Input and Auxiliary Circuit Wiring Diagram – Figure F.10
Machine Wiring Diagram in the Electrical Diagrams section of this manual
Protection PC Board Schematic in the Electrical Diagrams section of this manual

This procedure takes approximately 20 minutes to perform.

AUXILIARY TRANSFORMER PRIMARY WIRING HARNESS TEST *(continued)*

FIGURE F.9 - RECONNECT PANEL/TERMINAL STRIP LOCATION



1. RECONNECT PANEL (ON LEFT SIDE)
2. TERMINAL STRIP
3. FAN MOTORS
4. AUXILIARY TRANSFORMERS

TEST PROCEDURE

1. Remove main input supply power to the machine.
2. With the 3/8" nut driver, remove the 4 screws that hold the handle to the machine.
3. Remove the rubber gasket (cover seal) from the lift bail.
4. With the 5/16" nut driver, remove the sheet metal screws from the case top.
5. With the 5/16" nut driver, remove the screws holding the right and left case sides. Remove the case sides by lifting up and out.
6. Perform the ***Capacitor Discharge Procedure*** described in this section of the manual.

⚠ WARNING



Before continuing with the test procedure, perform the capacitor discharge procedure to avoid electric shock.

7. After you have completed the capacitor discharge procedure for all four switch boards, remove the PC board cover. Use the 5/16" nut driver.
8. Remove the 5 leads (3 heavy and 2 small) T1, T2, T3 from main input contactor CR1. This is a safety precaution. It prevents high voltage from being put on the machine during the test. Wrap tape around the lead ends to insulate them and prevent them from touching.
9. Remove plug J30 from the protection board. See ***Figure F.1*** for location of the board and plug J30.

NOTE: If removing plug J30 solves the problem, check for a short circuit or a fault in the 24 VAC circuit (plug P71) and the main contactor coil. See the Input and Auxiliary Circuit Wiring Diagram, ***Figure F.10.***

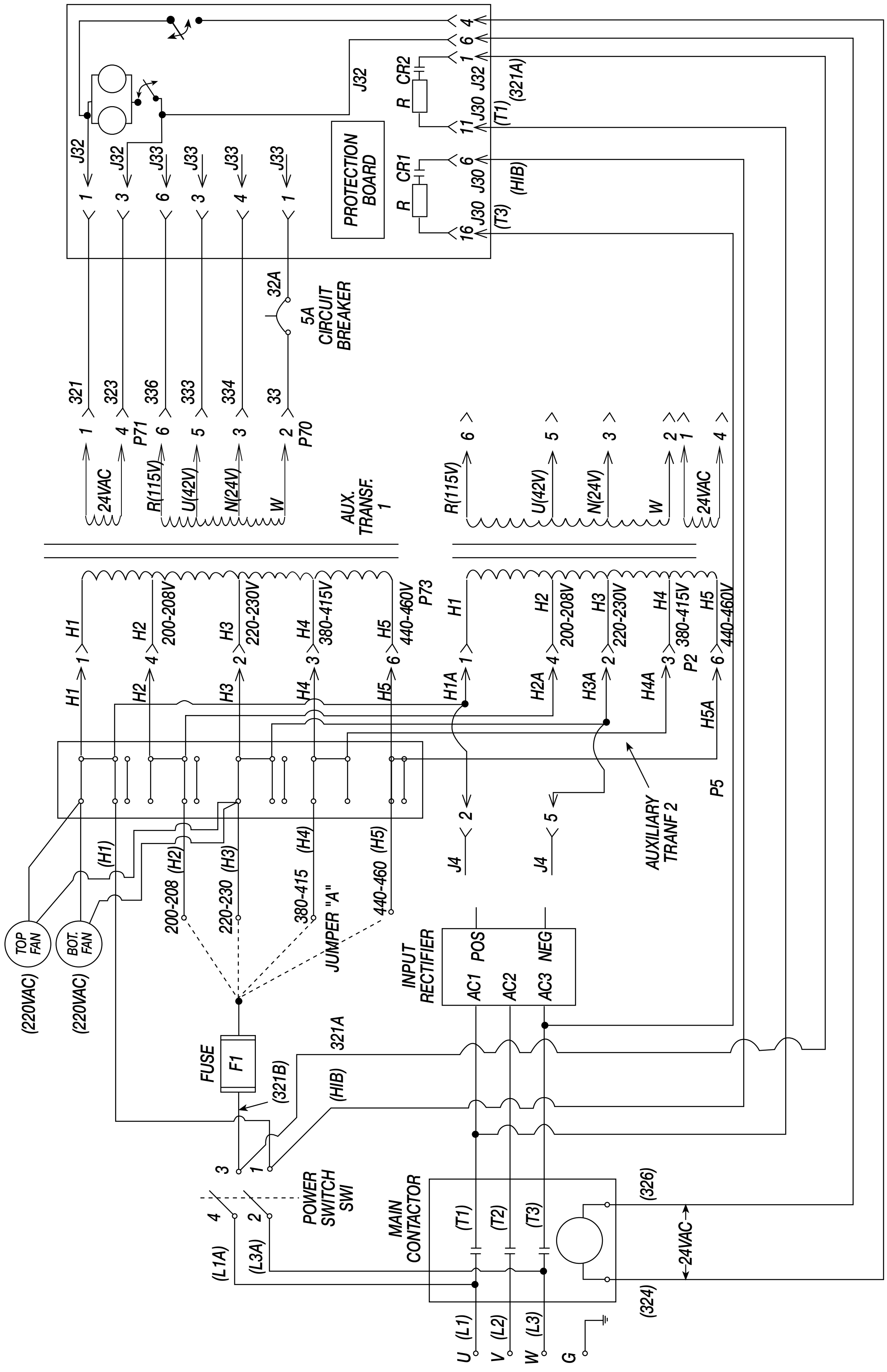
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Return to Master TOC
Return to Section TOC
Return to Master TOC

AUXILIARY TRANSFORMER PRIMARY WIRING HARNESS TEST *(continued)*

10. Check the wires that run from the reconnect panel to the terminal strip. Look for shorts between wires caused by broken or burned insulation. See the Input and Auxiliary Circuit Wiring Diagram, ***Figure F.10.***
11. Check for shorts in the wires that run from the terminal strip to the auxiliary transformers and to the fan motors.
12. The fan motors or the auxiliary transformer may be faulty. Disconnect these components one at a time and see if fuse F1 blows when input power is applied. The internal resistance of the fan motors should be about 16 ohms.
13. Remove plug P70 from the transformer. If this solves the problem, check for a short in the secondary circuit. See the machine Wiring Diagram and the Protection PC Board Schematic in the Electrical Diagrams section of this manual.
14. After the test is completed and the problem successfully repaired, reconnect plug J30 to the protection board.
15. Reconnect plugs P70 and P71 to the T1 transformer.
16. Reconnect the 5 leads to the main contactor CR1.
17. Install the PC board cover.
18. Install the machine case sides and top.
19. Install the handle and the lift bail rubber gasket.

Return to Section TOC
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Return to Master TOC

FIGURE F.10 – INPUT AND AUXILIARY CIRCUIT WIRING DIAGRAM



AUXILIARY TRANSFORMER #1 SECONDARY AND WIRING HARNESS TEST

WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-800-833-9353 (WELD).

TEST DESCRIPTION

This test will determine if there are any short circuits or other problems in the load circuits fed by the secondary windings of the auxiliary transformer, which would cause the transformer to overheat or the fuse (F1 - primary side) on the reconnect panel to blow.

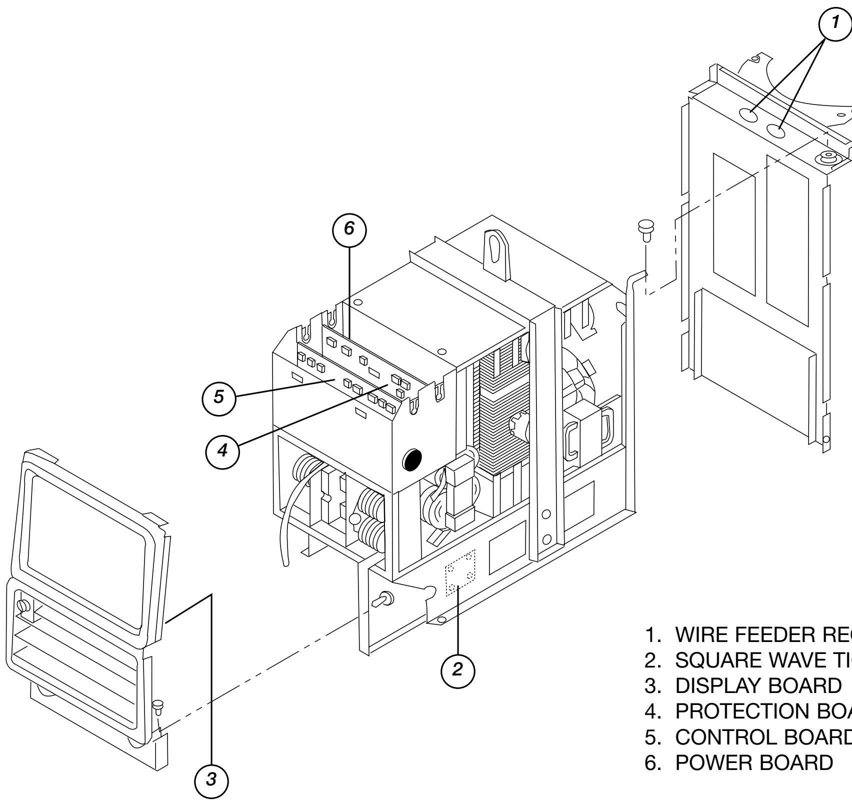
MATERIALS NEEDED

Volt/Ohmmeter (Multimeter)
5/16" Nut driver
3/8" Nut driver
Auxiliary Transformer #1 Secondary Circuit Wiring Diagram – Figure F.12

This procedure takes approximately 30 minutes to perform.

AUXILIARY TRANSFORMER #1 SECONDARY AND WIRING HARNESS TEST *(continued)*

FIGURE F.11 - PLUG AND RECEPTACLE INSPECTION POINTS



1. WIRE FEEDER RECEPTACLES
2. SQUARE WAVE TIG PROTECTION BOARD
3. DISPLAY BOARD
4. PROTECTION BOARD
5. CONTROL BOARD
6. POWER BOARD

TEST PROCEDURE

1. Remove main input supply power to the machine.
2. With the 3/8" nut driver, remove the 4 screws that hold the handle to the machine.
3. Remove the rubber gasket (cover seal) from the lift bail.
4. With the 5/16" nut driver, remove the sheet metal screws from the case top.
5. With the 5/16" nut driver, remove the screws holding the right and left case sides. Remove the case sides by lifting up and out.
6. Perform the ***Capacitor Discharge Procedure*** described earlier in this section of the manual.

⚠ WARNING



Before continuing with the test procedure, perform the capacitor discharge procedure to avoid electric shock.

7. After you have completed the capacitor discharge procedure for all four switch boards, remove the PC board cover. Use the 5/16" nut driver.
8. Disconnect all plugs and wirefeeder receptacles associated with the auxiliary transformer secondary. This is done to isolate the machine electrically. Inspect all the disconnected plugs and receptacles, looking for shorted pins and wires. See the Auxiliary Transformer #1 Secondary Circuit Wiring Diagram, ***Figure F.12***, for the specific plugs and receptacles to check, which include:
   - WF2 Receptacle
   - WF1 Receptacle
   - Square Wave TIG Protection Board
   - Display Board
   - Power Board
   - Protection Board
9. Check for shorts on the associated PC boards. See the Auxiliary Transformer #1 Secondary Circuit Wiring Diagram, ***Figure F.12.***

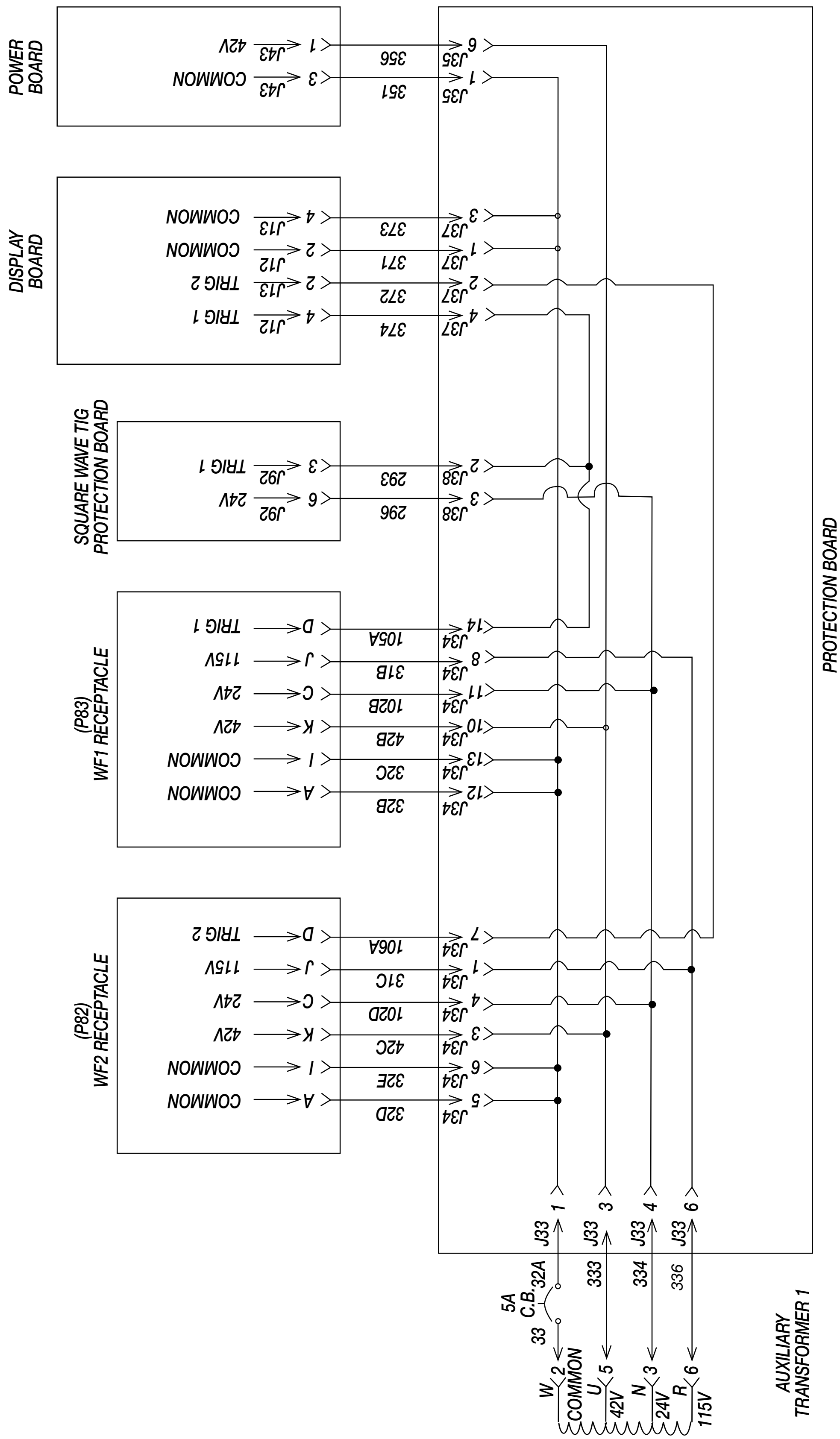
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Return to Master TOC

AUXILIARY TRANSFORMER #1 SECONDARY AND WIRING HARNESS TEST *(continued)*

10. Check for shorts at plugs J33, J34, J35, J37, and J38 on the protection board. Inspect the board for evidence of arcing.
11. After the test is completed and the problem successfully repaired, reconnect all plugs disconnected for the test.
12. Install the PC board cover.
13. Install the machine case sides and top.
14. Install the handle and the lift bail rubber gasket.

Return to Section TOC
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FIGURE F.12
AUXILIARY TRANSFORMER #1 SECONDARY CIRCUIT WIRING DIAGRAM



Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC

INPUT POWER AND WIRING HARNESS TEST

⚠ WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-800-833-9353 (WELD).

TEST DESCRIPTION

This test will determine if there are any short circuits or other problems on the input power circuit that would cause the input fuses to repeatedly blow.

MATERIALS NEEDED

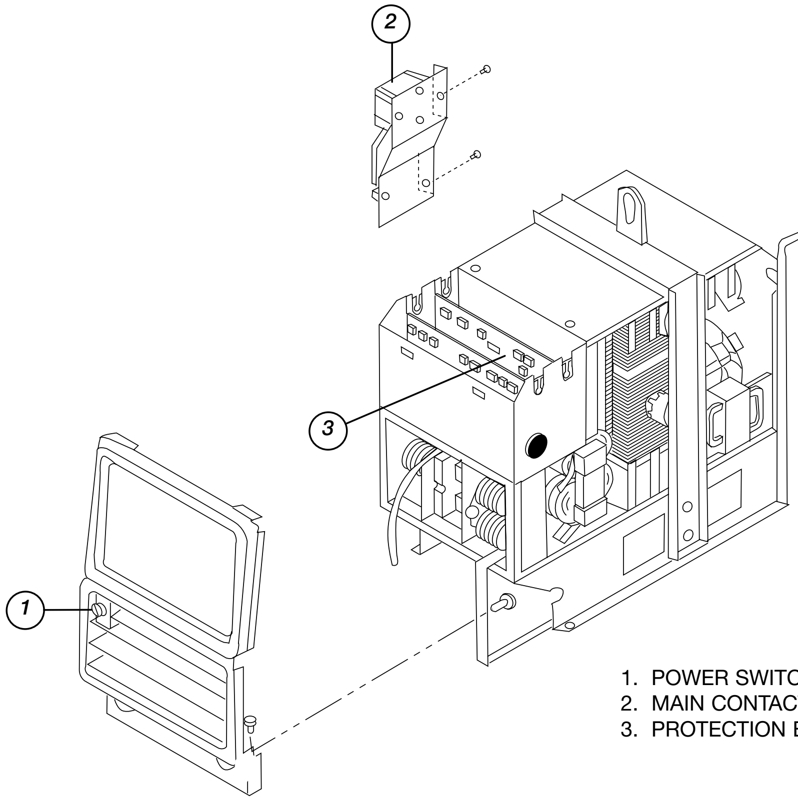
Volt/Ohmmeter (Multimeter)
5/16" Nut driver
3/8" Nut driver
Input and Auxiliary Circuit Wiring Diagram – Figure F.14

This procedure takes approximately 20 minutes to perform.

Return to Section TOC
Return to Master TOC

INPUT POWER AND WIRING HARNESS TEST

FIGURE F.13 - INPUT POWER INSPECTION POINTS



1. POWER SWITCH (S1)
2. MAIN CONTACTOR INPUT LEADS (TOP)
3. PROTECTION BOARD

TEST PROCEDURE

1. Remove main input supply power to the machine.
2. With the 3/8" nut driver, remove the 4 screws that hold the handle to the machine.
3. Remove the rubber gasket (cover seal) from the lift bail.
4. With the 5/16" nut driver, remove the sheet metal screws from the case top.
5. With the 5/16" nut driver, remove the screws holding the right and left case sides. Remove the case sides by lifting up and out.
6. Perform the ***Capacitor Discharge Procedure*** described earlier in this section of the manual.

⚠ WARNING



Before continuing with the test procedure, perform the capacitor discharge procedure to avoid electric shock.

7. After you have completed the capacitor discharge procedure for all four switch boards, remove the PC board cover. Use the 5/16" nut driver.
8. Manually check the power switch (S1) for proper operation by turning it back and forth. At the back of the front panel where the switch is mounted, make a visual inspection. Be sure the input and output leads are not shorted together. Make sure the switch contacts are not fused together or shorted to another phase. (Because of the high input voltage involved, you should be able to see physical evidence if any of these problems exist.) Remove the tape covering the switch and check the switch with an ohmmeter. High resistance should be present.

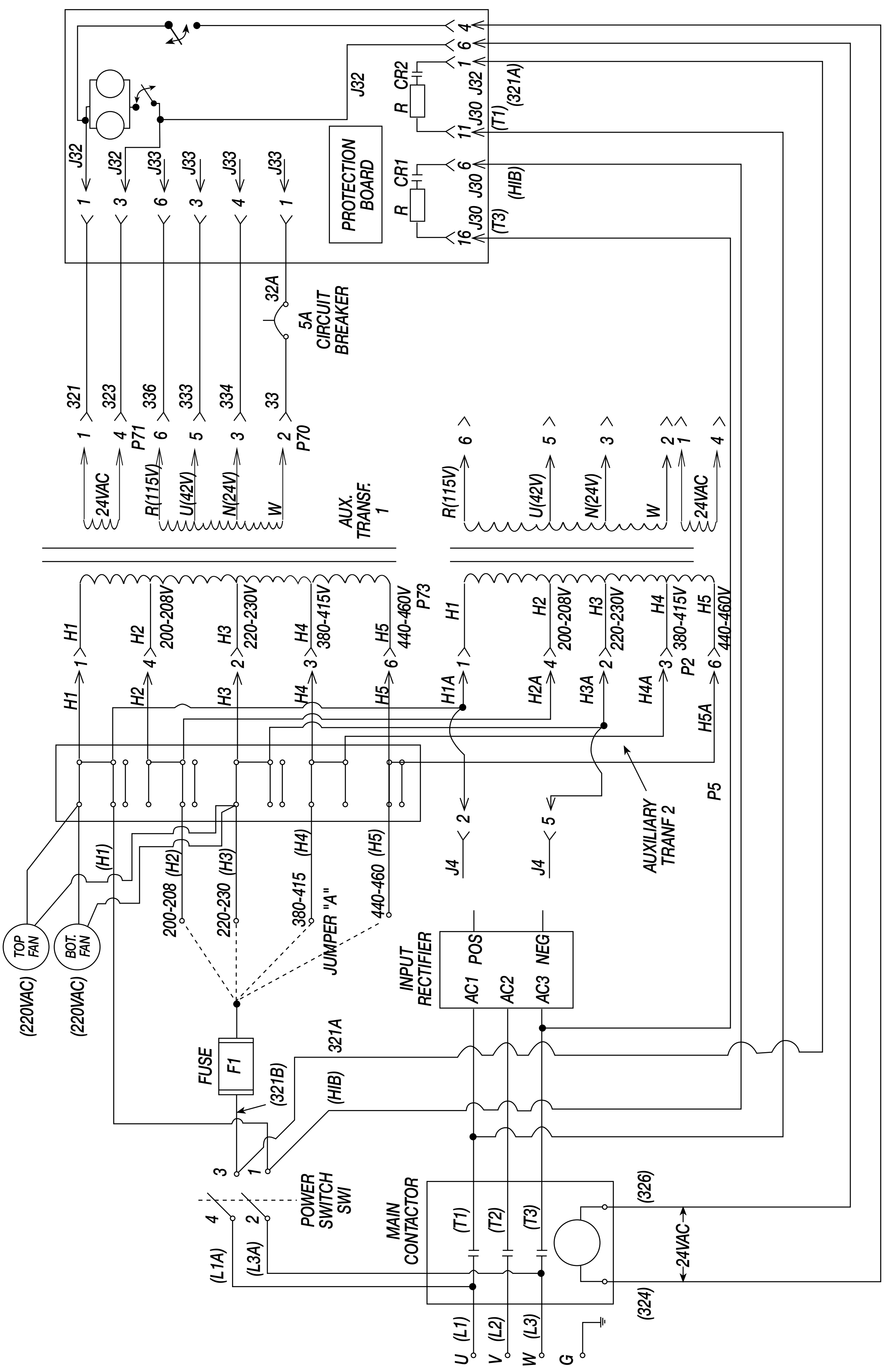
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INPUT POWER AND WIRING HARNESS TEST *(continued)*

9. Check for shorts or fusing at the input (top) leads to the main contactor.
10. Remove plug J30 from the protection board. Check the resistance on the J30 header (the plug mounted on the board) between pin 1 and pin 6. Resistance should be very high. If resistance is low or zero ohms, the protection board is faulty.
11. Check plug J30 and associated wires for shorts or damaged connections. See the Input and Auxiliary Circuit Wiring Diagram, ***Figure F.14.***
12. If any of the tests reveal signs of heavy current flow, check the switch boards and the input rectifier. Refer to the ***Switch Board Test*** and the ***Input Rectifier Resistance Test*** in this section of the manual.
13. After the test is completed and the problem successfully repaired, reconnect all plugs disconnected for the test.
14. Install the PC board cover.
15. Install the machine case sides and top.
16. Install the handle and the lift bail rubber gasket.

Return to Section TOC
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Return to Section TOC
Return to Master TOC

FIGURE F.14 – INPUT AND AUXILIARY CIRCUIT WIRING DIAGRAM



INPUT RECTIFIER RESISTANCE TEST

WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-800-833-9353 (WELD).

TEST DESCRIPTION

This test will determine if any of the internal diodes in the three-phase rectifier are shorted or open.

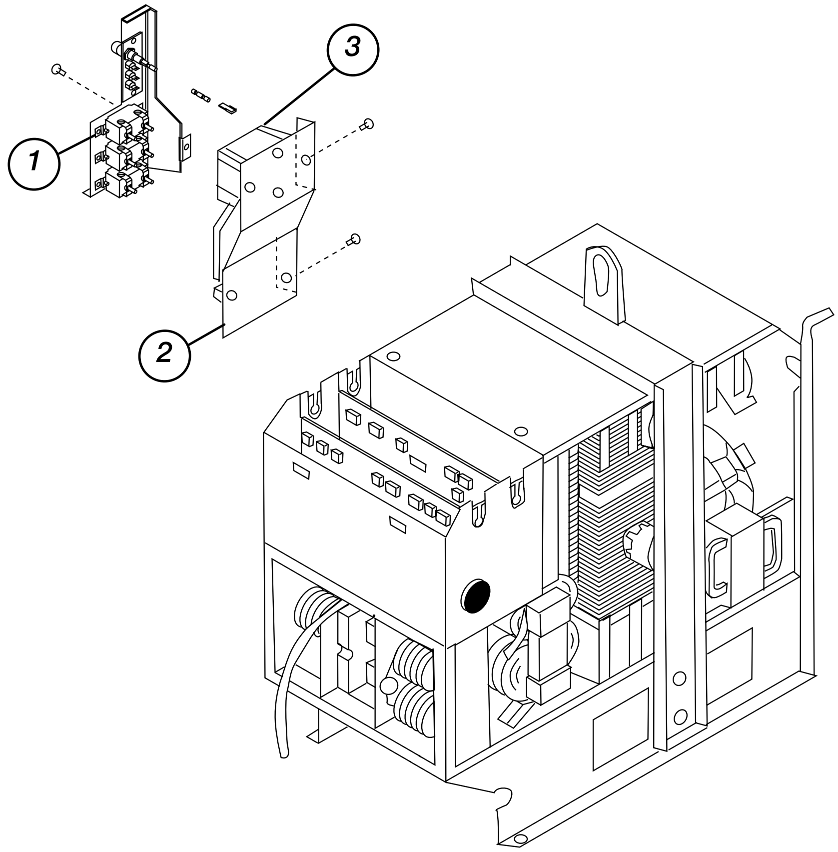
MATERIALS NEEDED

Analog Volt/Ohmmeter (Multimeter)
5/16" Nut driver
3/8" Nut driver
Machine Wiring Diagram in the Electrical Diagrams section of this manual

This procedure takes approximately 35 minutes to perform.

INPUT RECTIFIER RESISTANCE TEST *(continued)*

FIGURE F.15 - RECONNECT SWITCH LOCATION



1. RECONNECT SWITCH
2. INPUT RECTIFIER
3. MAIN CONTACTOR

TEST PROCEDURE

1. Remove main input supply power to the machine.
2. With the 3/8" nut driver, remove the 4 screws that hold the handle to the machine.
3. Remove the rubber gasket (cover seal) from the lift bail.
4. With the 5/16" nut driver, remove the sheet metal screws from the case top.
5. With the 5/16" nut driver, remove the screws holding the right and left case sides. Remove the case sides by lifting up and out.
6. Perform the ***Capacitor Discharge Procedure*** described earlier in this section of the manual.

⚠ WARNING



Before continuing with the test procedure, perform the capacitor discharge procedure to avoid electric shock.

7. After you have completed the capacitor discharge procedure for all four switch boards, use the 5/16" nut driver to remove the two 5/16" sheet metal screws holding the reconnect switch assembly. Twist the reconnect switch out to access the lead connections on the back.
8. Use the 3/8" wrench to disconnect the two negative leads from the reconnect switch. By disconnecting the leads at the reconnect switch, you will not have to disturb the silicon applied to the input rectifier. Electrically isolate the leads from all other leads.

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Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC

INPUT RECTIFIER RESISTANCE TEST *(continued)*

9. Check all leads connected to the input rectifier. Check for looseness or shorted wires.

10. Using an analog type meter, perform the resistance test Steps A through L according to the Table F.1.

NOTE: If terminals AC1, AC2, and AC3 of the input rectifier are not easily accessible, use terminals T1, T2, and T3, respectively, of main contactor CR1 for the resistance measurements. Similarly, if terminals POS and NEG of the input rectifier are not easily accessible, use terminals POS and NEG of the reconnect switch for the resistance measurements.

11. After the test is completed and the problem successfully repaired, reconnect the negative leads to the reconnect switch. Fasten the reconnect switch assembly back into position on the machine.

NOTE: If input rectifier was shorted, other components may be faulty. Perform ***Field Effect Transistor/ Switch Board Test*** and check for "leaky" or "shorted" capacitors.

12. Install the machine case sides and top.

13. Install the handle and the lift bail rubber gasket.

TABLE F.1 – INPUT RECTIFIER RESISTANCE VALUES

Step (See Note)	Test for	Place + Lead on . . .	Place - Lead on . . .	If . . .	Then . . .
A	1K Ohms	POS	AC1	>1K Ohms <100 Ohms	Go to step B. Tested failed.
B	1K Ohms	POS	AC2	>1K Ohms <100 Ohms	Go to step C. Tested failed.
C	1K Ohms	POS	AC3	>1K Ohms <100 Ohms	Go to step D. Tested failed.
D	1K Ohms	AC1	NEG	>1K Ohms <100 Ohms	Go to step E. Tested failed.
E	1K Ohms	AC2	NEG	>1K Ohms <100 Ohms	Go to step F. Tested failed.
F	1K Ohms	AC3	NEG	>1K Ohms <100 Ohms	Go to step G. Tested failed.
G	<100 Ohms	AC1	POS	<100 Ohms >1K Ohms	Go to step H. Test failed.
H	<100 Ohms	AC2	POS	<100 Ohms >1K Ohms	Go to step I. Test failed.
I	<100 Ohms	AC3	POS	<100 Ohms >1K Ohms	Go to step J. Test failed.
J	<100 Ohms	NEG	AC1	<100 Ohms >1K Ohms	Go to step K. Test failed.
K	<100 Ohms	NEG	AC2	<100 Ohms >1K Ohms	Go to step L. Test failed.
L	<100 Ohms	NEG	AC3	<100 Ohms >1K Ohms	Input Rectifier OK Test failed.

NOTES

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Return to Section TOC Return to Master TOC
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Return to Section TOC Return to Master TOC

OUTPUT SHUNT/WELDING FEEDBACK TEST

⚠ WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-800-833-9353 (WELD).

TEST DESCRIPTION

The following procedure will determine whether the shunt amplifier board is receiving the correct supply voltage from the control board and providing the correct feedback voltage.

MATERIALS NEEDED

Volt/Ohmmeter (Multimeter)
5/16" Nut driver
3/8" Nut driver
Machine Wiring Diagram in the Electrical Diagrams section of this manual
Load Bank

This procedure takes approximately 40 minutes to perform.

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QUICK SHUNT TEST

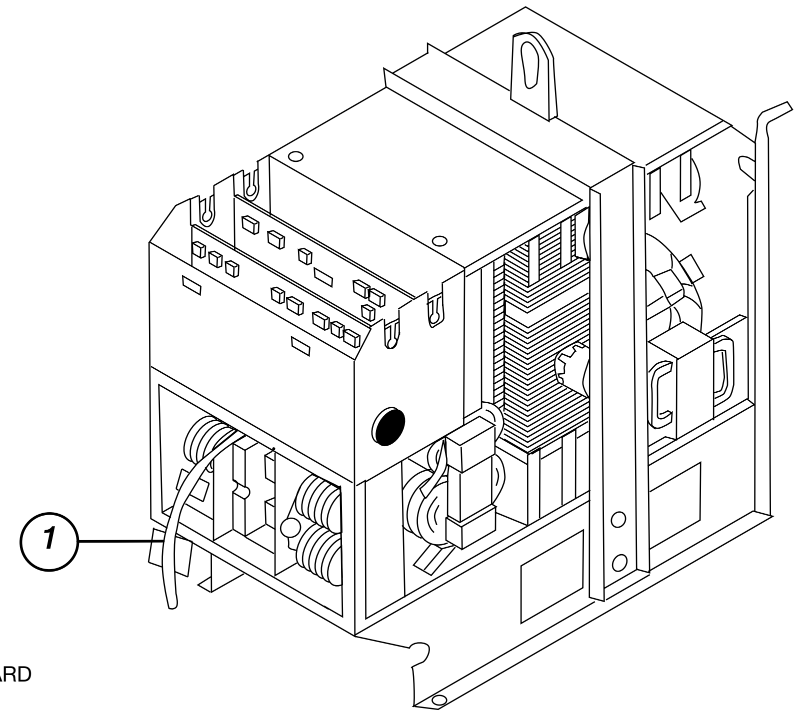
TEST PROCEDURE

1. Remove main input supply power to the Power Wave 450.
2. Disconnect the Output leads from the machine.
3. If a wire feeder is connected to the Power Wave 450, release the drive roll tension so the unit will not feed wire when the trigger is activated.
4. Turn on the Power Wave 450 and activate the gun trigger and hold for several seconds. Trigger the machine on and off several times in this manner and observe the display. The “I=” reading should be less than five amps when the machine is triggered and NOT welding.
5. If after several trigger cycles the “I=” value is at or above 5 amps the shunt assembly is suspect and should be replaced.
6. If the “I=” value is below 5 amps when the trigger is activated and not welding, the stability of the shunt assembly is at an acceptable level.
7. To further test the shunt assembly, continue with the output shunt/welding feedback test.

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Return to Master TOC

OUTPUT SHUNT/WELDING FEEDBACK TEST *(continued)*

FIGURE F.16 - SHUNT AMPLIFIER BOARD LOCATION



1. SHUNT AMPLIFIER BOARD

TEST PROCEDURE

1. Remove main input supply power to the machine.
2. With the 3/8" nut driver, remove the 4 screws that hold the handle to the machine.
3. Remove the rubber gasket (cover seal) from the lift bail.
4. With the 5/16" nut driver, remove the sheet metal screws from the case top.
5. With the 5/16" nut driver, remove the screws holding the right and left case sides. Remove the case sides by lifting up and out.
6. Perform the ***Capacitor Discharge Procedure*** described earlier in this section of the manual.

WARNING



Before continuing with the test procedure, perform the capacitor discharge procedure to avoid electric shock.

7. After you have completed the capacitor discharge procedure for all four switch boards, locate plug J50 at the shunt amplifier board. Locate the plug and insert your voltmeter positive (+) probe into pin 3 and negative probe (-) into pin 1. Right-angle probes are recommended.
8. Turn supply power to the machine ON.

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Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC

OUTPUT SHUNT/WELDING FEEDBACK TEST *(continued)*

⚠ WARNING



ELECTRIC SHOCK can kill.

Proceed with caution. Be careful not to touch any internal machine components during the remainder of the test procedure.

9. Check for +15 VDC between plug J50 - pin 3+ and J50 - pin 1-.
10. Carefully move the probes, placing the negative probe (-) at plug J50 - pin 6 and the positive (+) probe at J50 - pin 1. Check for -15 VDC.
11. If the voltage readings are NOT correct, check the associated wiring to the control board. If the wiring is okay, the control board may be faulty. Replace the control board. Refer to the ***Printed Circuit Board Removal and Replacement Procedure*** in this section of the manual.
12. If the supply voltage readings are correct, load the machine to 400 amps.

⚠ CAUTION

Do not run the machine under load for more than 15 sec. with case removed.

13. Use a current probe to check for 5 ma of current through lead #218 (plug J50 - pin 4). This also reads approximately 1 VDC if you use a voltmeter.
14. If the current reading is NOT correct, the shunt amplifier board may be faulty. Replace the shunt amplifier assembly and perform current calibration.
15. If the current reading IS correct, the control board may be faulty. Replace the control board. Refer to the Printed Circuit Board Removal and Replacement procedure in this section of the manual.
16. After the test is completed and the problem successfully repaired, install the machine case sides and top.
17. Install the handle and the lift bail rubber gasket.

PIEZO-ELECTRIC ALARM BUZZER TEST

⚠ WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-800-833-9353 (WELD).

DESCRIPTION

The following procedure will determine whether the piezo-electric alarm buzzer is functioning properly.

MATERIALS NEEDED

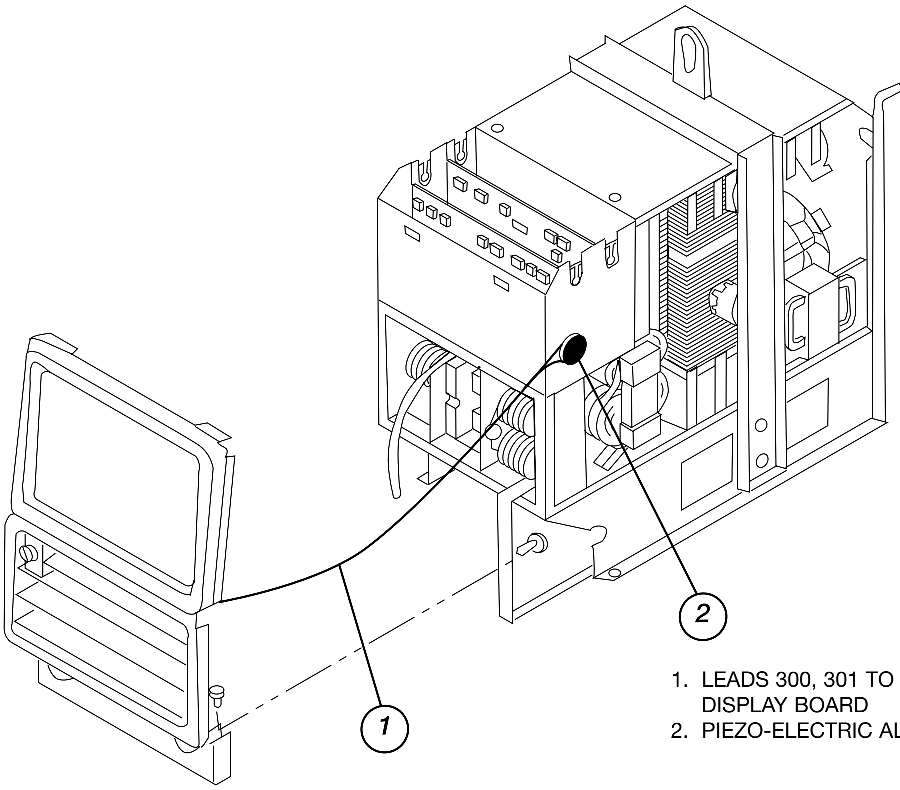
Volt/Ohmmeter (Multimeter)
5/16" Nut driver
3/8" Nut driver
Machine Wiring Diagram in the Electrical Diagrams section of this manual

This procedure takes approximately 30 minutes to perform.

Return to Section TOC
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Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC

PIEZO-ELECTRIC ALARM BUZZER TEST

FIGURE F.17 - ALARM BUZZER LOCATION



1. LEADS 300, 301 TO PLUG J15 ON DISPLAY BOARD
2. PIEZO-ELECTRIC ALARM BUZZER

TEST PROCEDURE

1. Remove main input supply power to the machine.
2. With the 3/8" nut driver, remove the 4 screws that hold the handle to the machine.
3. Remove the rubber gasket (cover seal) from the lift bail.
4. With the 5/16" nut driver, remove the sheet metal screws from the case top.
5. With the 5/16" nut driver, remove the screws holding the right and left case sides. Remove the case sides by lifting up and out.
6. Perform the ***Capacitor Discharge Procedure*** described earlier in this section of the manual.

⚠ WARNING



Before continuing with the test procedure, perform the capacitor discharge procedure to avoid electric shock.

7. After you have completed the capacitor discharge procedure for all four switch boards, locate and remove plug J15 from the display board. See Figure F.17 for location.
8. Using lead #300 as positive (+) and lead #301 as negative (-), apply 12 to 15 VDC to the piezo-electric buzzer.
9. If the buzzer does not work, replace it.
10. If the buzzer does work, the display board may be faulty. Replace the display board. Refer to the Display Board Replacement procedure in this section of the manual.
11. After the test is completed and the problem successfully repaired, reconnect plug J15 to the display board.
12. Install the machine case sides and top.
13. Install the handle and the lift bail rubber gasket.

Return to Section TOC
Return to Master TOC

OUTPUT RECTIFIER DIODES TEST

WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-800-833-9353 (WELD).

TEST DESCRIPTION

The following procedure will determine whether one of the output rectifier diodes is shorted. If one of the diodes is shorted, the output rectifier assembly must be replaced.

MATERIALS NEEDED

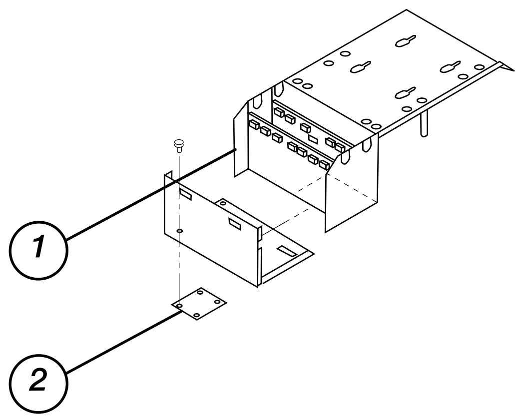
Analog Volt/Ohmmeter (Multimeter)
5/16" Nut driver
3/8" Nut driver
Machine Wiring Diagram in the Electrical Diagrams section of this manual

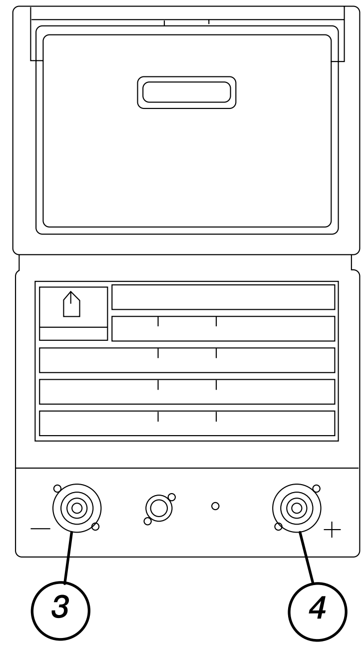
This procedure takes approximately 15 minutes to perform.

TROUBLESHOOTING & REPAIR

OUTPUT RECTIFIER DIODES TEST

FIGURE F.18 - SNUBBER BOARD, OUTPUT TERMINAL LOCATION





1. PC BOARD FRONT/BOTTOM COVER
2. SNUBBER PC BOARD
3. NEGATIVE OUTPUT TERMINAL
4. POSITIVE OUTPUT TERMINAL

TEST PROCEDURE

1. Remove main input supply power to the machine.
2. With the 3/8" nut driver, remove the 4 screws that hold the handle to the machine.
3. Remove the rubber gasket (cover seal) from the lift bail.
4. With the 5/16" nut driver, remove the sheet metal screws from the case top.
5. With the 5/16" nut driver, remove the screws holding the right and left case sides. Remove the case sides by lifting up and out.
6. Perform the ***Capacitor Discharge Procedure*** described earlier in this section of the manual.

WARNING



Before continuing with the test procedure, perform the capacitor discharge procedure to avoid electric shock.

7. After you have completed the capacitor discharge procedure for all four switch boards, disconnect plug J62 from the snubber board. See Figure F.18 for location.
8. Remove any output load that may be connected to the machine.
9. With the volt/ohmmeter, measure the resistance between the positive and negative output terminals. **IMPORTANT: The positive (+) probe must be attached to the positive (+) output terminal and the negative probe (-) must be attached to the negative (-) output terminal.**
10. If the reading is 40 ohms, the output rectifier diodes are good. If the reading is less than 40 ohms, replace the output rectifier. Refer to the ***Output Rectifier Replacement Procedure*** in this section of the manual.
11. After the test is completed and the problem successfully repaired, reconnect plug J62 to the snubber board.
12. Install the machine case sides and top.
13. Install the handle and the lift bail rubber gasket.

FIELD EFFECT TRANSISTOR/SWITCH BOARD TEST OR IGBT/SWITCH BOARD TEST

⚠ WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-800-833-9353 (WELD).

DESCRIPTION

The following procedure will determine if the four switch boards and their related circuitry are functioning properly. This is a resistance test, not a voltage test. The machine does not have to be powered up to perform the test, which is both safer for the technician and less likely to result in accidental damage to the switch boards.

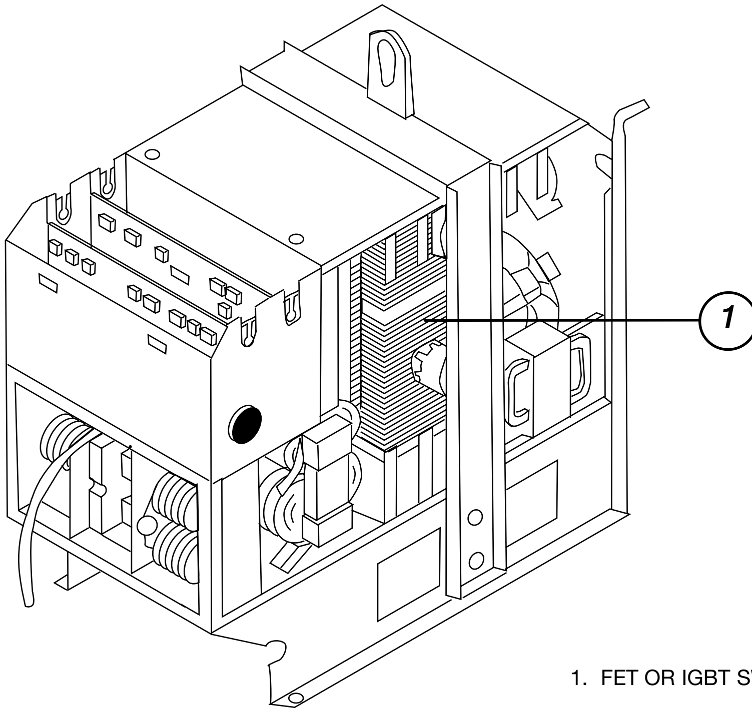
MATERIALS NEEDED

Analog Volt/Ohmmeter (Multimeter)
5/16" Nut driver
3/8" Nut driver
Machine Wiring Diagram in the Electrical Diagrams section of this manual

This procedure takes approximately 60 minutes to perform.

FIELD EFFECT TRANSISTOR/SWITCH BOARD TEST

FIGURE F.19 – F.E.T. SWITCH BOARD LOCATION



1. FET OR IGBT SWITCH BOARD ASSEMBLY

TEST PROCEDURE

1. Remove main input supply power to the machine.
2. With the 3/8" nut driver, remove the screws that hold the handle to the machine.
3. Remove the rubber gasket (cover seal) from the lift bail.
4. With the 5/16" nut driver, remove the sheet metal screws from the case top.
5. With the 5/16" nut driver, remove the screws holding the right and left case sides. Remove the case sides by lifting up and out.

WARNING



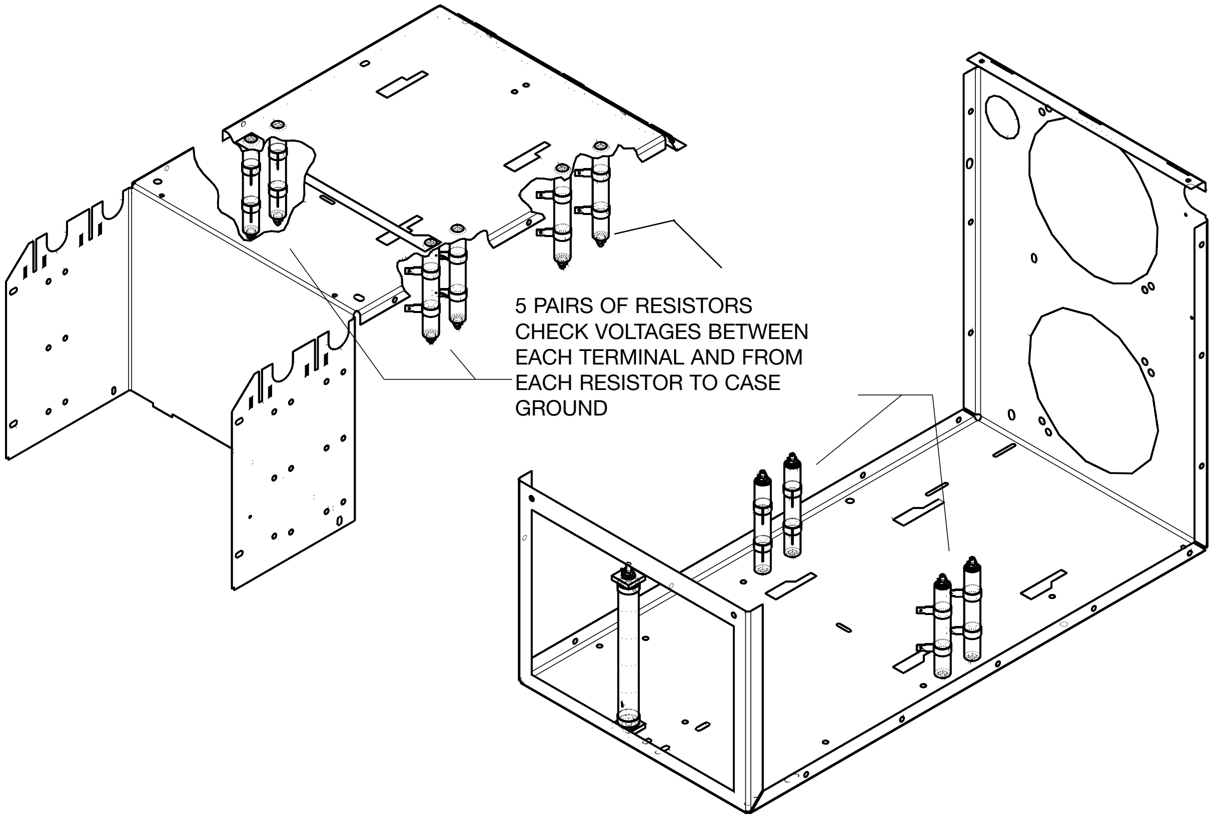
Before continuing with the test procedure, perform the following capacitor discharge procedure to avoid electric shock.

6. Obtain a high resistance and high wattage resistor (25 - 1000 ohms and 25 watts minimum). This resistor is not supplied with the machine. Secure this resistor to a piece of insulating material such as a glastic board. See Figure F.22. NEVER USE A SHORTING STRAP FOR THIS PROCEDURE.

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FIELD EFFECT TRANSISTOR/SWITCH BOARD TEST *(continued)*

FIGURE F.20 - RESISTOR LOCATIONS



7. Locate the two sets of two resistors on the left side of the machine and three sets of two resistors on the right side of the machine. See Figure F.20. Do not touch the resistors or any other internal machine component. Using a DC voltmeter, check for any DC voltage that may be present across the terminals of each resistor and from each resistor to case ground (20 measurements in all). If a voltage is present, be careful not to touch these resistors.

WARNING



ELECTRIC SHOCK can kill.

Proceed with caution. Be careful not to touch any internal machine components during the discharge procedure.

8. Locate terminals #9 and #12 on the switch boards. They can be identified by the "Discharge" labels, which are located on each of the four switch boards. See ***Figure F.21.***

FIELD EFFECT TRANSISTOR/SWITCH BOARD TEST *(continued)*

FIGURE F.21 - DISCHARGE LABEL

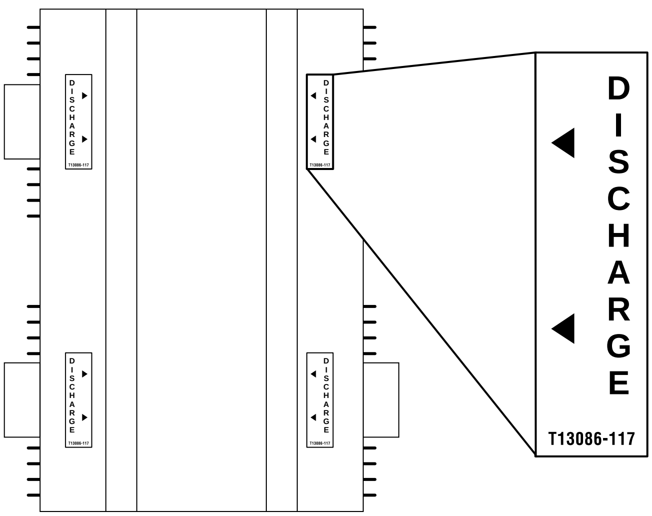
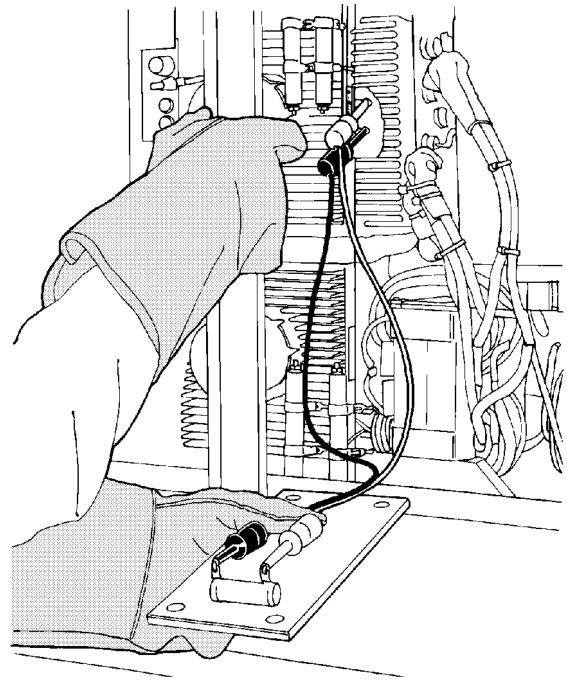


FIGURE F.22
RESISTOR WITH LEADS CONNECTED



9. Using insulated, needle nose type jumper leads and insulated gloves, connect one jumper lead to one end of the resistor obtained in step 6. Connect the other jumper lead to the other end of the resistor.

10. Carefully connect the needle nose end of one of the jumper leads to terminal #9. See Figure F.22. Connect the needle nose end of the other jumper lead to terminal #12. Terminals #9 and #12 are indicated by the "Discharge" label. Leave the resistor connected for 10 seconds. DO NOT TOUCH TERMINALS, RESISTORS, OR ANY INTERNAL MACHINE COMPONENTS DURING THIS PROCEDURE!

11. Check the voltage across terminals #9 and #12 with the DC voltmeter. Terminal #9 has positive polarity and terminal #12 has negative polarity. Voltage should be zero. If any voltage remains, repeat this capacitor discharge procedure.

12. Repeat discharge procedure steps 9, 10, and 11 for each of the other three switch boards.

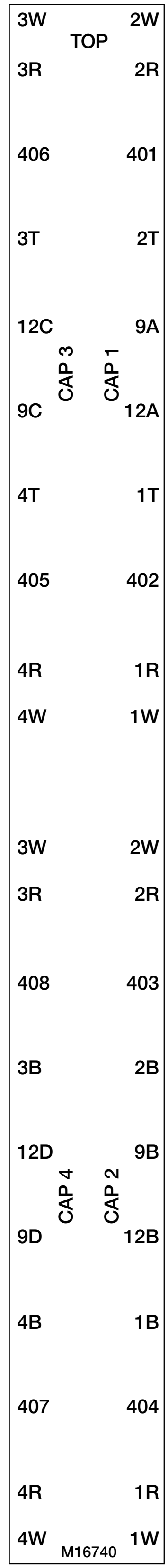
13. After you have completed the capacitor discharge procedure for all four switch boards, Visually inspect the switch boards. If any of them appear burned or overheated, replace all four switch boards and input filter capacitors C1, C2, C3, and C4. Refer to the ***FET Module Assembly Removal and Replacement Procedure*** in this section of the manual.

14. If none of the switch boards shows physical damage, test each switch board according to the procedures given below. If any test shows that one of the switch boards is damaged, replace all four switch boards and input filter capacitors C1, C2, C3, and C4. Refer to the ***FET Module Assembly Removal and Replacement Procedure*** in this section of the manual.

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Return to Master TOC
Return to Section TOC
Return to Master TOC

FIELD EFFECT TRANSISTOR/SWITCH BOARD TEST *(continued)*

FIGURE F.23 - SWITCH BOARD ASSEMBLY CONNECTION DECAL



FIELD EFFECT TRANSISTOR/SWITCH BOARD TEST *(continued)*

Switch Board Test 1: (For Switch Board Marked CAP 1 on the Switch Board Assembly Connection Decal - See *Figure F.23.*)

A. Disconnect all wiring harness leads from switch board 1. Fold the leads up so that they do not interfere with the exposed PC board terminals.

B. With the volt/ohmmeter, measure the resistance between terminals according to Table F. 2. See Figure F.23 for the locations of the terminals. If any test fails, replace all four switch boards. Refer to the FET Module Assembly Removal and Replacement procedure in this section of the manual.

If none of the tests fails, reconnect the wiring harness leads to switch board 1 and perform switch board test 2.

Switch Board Test 2: (For Switch Board Marked CAP 2 on the Switch Board Assembly Connection Decal - See *Figure F.23.*)

A. Disconnect all wiring harness leads from switch board 2. Fold the leads up so that they do not interfere with the exposed PC board terminals.

B. With the volt/ohmmeter, measure the resistance between terminals according to Table F. 3. If any test fails, replace all four switch boards. Refer to the FET Module Assembly Removal and Replacement procedure in this section of the manual.

If none of the tests fails, reconnect the wiring harness leads to switch board 2 and perform switch board test 3.

Switch Board Test 3: (For Switch Board Marked CAP 3 on the Switch Board Assembly Connection Decal - See *Figure F.23.*)

A. Disconnect all wiring harness leads from switch board 3. Fold the leads up so that they do not interfere with the exposed PC board terminals.

B. With the volt/ohmmeter, measure the resistance between terminals according to Table F. 4. If any test fails, replace all four switch boards. Refer to the FET Module Assembly Removal and Replacement procedure in this section of the manual.

If none of the tests fails, reconnect the wiring harness leads to switch board 3 and perform switch board test 4.

Switch Board Test 4: (For Switch Board Marked CAP 4 on the Switch Board Assembly Connection Decal - See *Figure F.23.*)

A. Disconnect all wiring harness leads from switch board 4. Fold the leads up so that they do not interfere with the exposed PC board terminals.

B. With the volt/ohmmeter, measure the resistance between terminals according to Table F. 5. If any test fails, replace all four switch boards. Refer to the FET Module Assembly Removal and Replacement procedure in this section of the manual.

If none of the tests fails, reconnect the wiring harness leads to switch board 4.

IGBT Switch Board Test (G3165-1) See *Table F.6.*

A. Disconnect all wiring harness leads from the switch boards. Fold the leads up so that they do not interfere with the exposed PC board terminals.

B. With the Volt/Ohmmeter, measure the resistance between terminals according to ***Table F.6.*** If any test fails, replace all four switch boards. Refer to the FET Module Assembly Removal and Replacement procedure in this section of the manual.

If none of the tests fail, reconnect the wiring harness leads to the switch boards.

15. After the test is completed and the problem successfully repaired, install the machine case sides and top.
16. Install the handle and the lift bail rubber gasket.

FIELD EFFECT TRANSISTOR/SWITCH BOARD TEST *(continued)*

TABLE F.2 – SWITCH BOARD 1 RESISTANCE TEST TABLE

Apply Positive Test Probe to Terminal	Apply Negative Test Probe to Terminal	Test Result	Conclusion	Repair Action	Next Procedure
2T	12A	Greater than 1K ohm	OK	None	Continue
		Less than 100 ohms	Shorted	Replace 4 Switch Boards	Snubber Resistor Test
12A	2T	Less than 100 ohms	OK	None	Continue
		Greater than 1K ohm	Open	Replace 4 Switch Boards	Snubber Resistor Test
9A	1T	Greater than 1K ohm	OK	None	Continue
		Less than 100 ohms	Shorted	Replace 4 Switch Boards	Snubber Resistor Test
1T	9A	Less than 100 ohms	OK	None	Continue
		Greater than 1K ohm	Open	Replace 4 Switch Boards	Snubber Resistor Test
2T	9A	Less than 100 ohms	OK	None	Continue
		Greater than 1K ohm	Open	Replace 4 Switch Boards	Snubber Resistor Test
9A	2T	Greater than 1K ohm	OK	None	Continue
		Less than 100 ohms	Shorted	Replace 4 Switch boards	Snubber Resistor Test

NOTE: K ohm = ohm reading multiplied by 1000.

NOTE: Always make sure that all four Switch Boards are changed at the same time. Never mix an old style (different part number) Switch Board with a new style (new part number).

FIELD EFFECT TRANSISTOR/SWITCH BOARD TEST *(continued)*

TABLE F.2 – SWITCH BOARD 1 RESISTANCE TEST TABLE *(Continued)*

Apply Positive Test Probe to Terminal	Apply Negative Test Probe to Terminal	Test Result	Conclusion	Repair Action	Next Procedure
12A	1T	Less than 100 ohms	OK	None	Continue
		Greater than 1K ohm	Open	Replace 4 Switch Boards	Snubber Resistor Test
1T	12A	Greater than 1K ohm	OK	None	Continue
		Less than 100 ohms	Shorted	Replace 4 Switch Boards	Snubber Resistor Test
12A	401	Greater than 1K ohm	OK	None	Continue
		Less than 100 ohms	Shorted	Replace 4 Switch Boards	Snubber Resistor Test
401	12A	Less than 100 ohms	OK	None	Continue
		Greater than 1K ohm	Open	Replace 4 Switch Boards	Snubber Resistor Test
9A	402	Less than 100 ohms	OK	None	Continue
		Greater than 1K ohm	Open	Replace 4 Switch Boards	Snubber Resistor Test
402	9A	Greater than 1K ohm	OK	None	Continue
		Less than 100 ohms	Shorted	Replace 4 Switch boards	Snubber Resistor Test

NOTE: K ohm = ohm reading multiplied by 1000.

NOTE: Always make sure that all four Switch Boards are changed at the same time. Never mix an old style (different part number) Switch Board with a new style (new part number).

Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC

FIELD EFFECT TRANSISTOR/SWITCH BOARD TEST *(continued)*

TABLE F.3 – SWITCH BOARD 2 RESISTANCE TEST TABLE

Apply Positive Test Probe to Terminal	Apply Negative Test Probe to Terminal	Test Result	Conclusion	Repair Action	Next Procedure
2B	12B	Greater than 1K ohm	OK	None	Continue
		Less than 100 ohms	Shorted	Replace 4 Switch Boards	Snubber Resistor Test
12B	2B	Less than 100 ohms	OK	None	Continue
		Greater than 1K ohm	Open	Replace 4 Switch Boards	Snubber Resistor Test
9B	1B	Greater than 1K ohm	OK	None	Continue
		Less than 100 ohms	Shorted	Replace 4 Switch Boards	Snubber Resistor Test
1B	9B	Less than 100 ohms	OK	None	Continue
		Greater than 1K ohm	Open	Replace 4 Switch Boards	Snubber Resistor Test
2B	9B	Less than 100 ohms	OK	None	Continue
		Greater than 1K ohm	Open	Replace 4 Switch Boards	Snubber Resistor Test
9B	2B	Greater than 1K ohm	OK	None	Continue
		Less than 100 ohms	Shorted	Replace 4 Switch boards	Snubber Resistor Test

NOTE: K ohm = ohm reading multiplied by 1000.

NOTE: Always make sure that all four Switch Boards are changed at the same time. Never mix an old style (different part number) Switch Board with a new style (new part number).

Return to Section TOC
Return to Master TOC

FIELD EFFECT TRANSISTOR/SWITCH BOARD TEST *(continued)*

TABLE F.3 – SWITCH BOARD 2 RESISTANCE TEST TABLE *(Continued)*

Apply Positive Test Probe to Terminal	Apply Negative Test Probe to Terminal	Test Result	Conclusion	Repair Action	Next Procedure
12B	1B	Less than 100 ohms	OK	None	Continue
		Greater than 1K ohm	Open	Replace 4 Switch Boards	Snubber Resistor Test
1B	12B	Greater than 1K ohm	OK	None	Continue
		Less than 100 ohms	Shorted	Replace 4 Switch Boards	Snubber Resistor Test
12B	403	Greater than 1K ohm	OK	None	Continue
		Less than 100 ohms	Shorted	Replace 4 Switch Boards	Snubber Resistor Test
403	12B	Less than 100 ohms	OK	None	Continue
		Greater than 1K ohm	Open	Replace 4 Switch Boards	Snubber Resistor Test
9B	404	Less than 100 ohms	OK	None	Continue
		Greater than 1K ohm	Open	Replace 4 Switch Boards	Snubber Resistor Test
404	9B	Greater than 1K ohm	OK	None	Continue
		Less than 100 ohms	Shorted	Replace 4 Switch boards	Snubber Resistor Test

NOTE: K ohm = ohm reading multiplied by 1000.

NOTE: Always make sure that all four Switch Boards are changed at the same time. Never mix an old style (different part number) Switch Board with a new style (new part number).

FIELD EFFECT TRANSISTOR/SWITCH BOARD TEST *(continued)*

TABLE F.4 – SWITCH BOARD 3 RESISTANCE TEST TABLE

Apply Positive Test Probe to Terminal	Apply Negative Test Probe to Terminal	Test Result	Conclusion	Repair Action	Next Procedure
4T	12C	Greater than 1K ohm	OK	None	Continue
		Less than 100 ohms	Shorted	Replace 4 Switch Boards	Snubber Resistor Test
12C	4T	Less than 100 ohms	OK	None	Continue
		Greater than 1K ohm	Open	Replace 4 Switch Boards	Snubber Resistor Test
9C	3T	Greater than 1K ohm	OK	None	Continue
		Less than 100 ohms	Shorted	Replace 4 Switch Boards	Snubber Resistor Test
3T	9C	Less than 100 ohms	OK	None	Continue
		Greater than 1K ohm	Open	Replace 4 Switch Boards	Snubber Resistor Test
4T	9C	Less than 100 ohms	OK	None	Continue
		Greater than 1K ohm	Open	Replace 4 Switch Boards	Snubber Resistor Test
9C	4T	Greater than 1K ohm	OK	None	Continue
		Less than 100 ohms	Shorted	Replace 4 Switch boards	Snubber Resistor Test

NOTE: K ohm = ohm reading multiplied by 1000.

NOTE: Always make sure that all four Switch Boards are changed at the same time. Never mix an old style (different part number) Switch Board with a new style (new part number).

Return to Section TOC
Return to Master TOC

FIELD EFFECT TRANSISTOR/SWITCH BOARD TEST *(continued)*

TABLE F.4 – SWITCH BOARD 3 RESISTANCE TEST TABLE *(Continued)*

Apply Positive Test Probe to Terminal	Apply Negative Test Probe to Terminal	Test Result	Conclusion	Repair Action	Next Procedure
12C	3T	Less than 100 ohms Greater than 1K ohm	OK Open	None Replace 4 Switch Boards	Continue Snubber Resistor Test
3T	12C	Greater than 1K ohm Less than 100 ohms	OK Shorted	None Replace 4 Switch Boards	Continue Snubber Resistor Test
12C	405	Greater than 1K ohm Less than 100 ohms	OK Shorted	None Replace 4 Switch Boards	Continue Snubber Resistor Test
405	12C	Less than 100 ohms Greater than 1K ohm	OK Open	None Replace 4 Switch Boards	Continue Snubber Resistor Test
9C	406	Less than 100 ohms Greater than 1K ohm	OK Open	None Replace 4 Switch Boards	Continue Snubber Resistor Test
406	9C	Greater than 1K ohm Less than 100 ohms	OK Shorted	None Replace 4 Switch boards	Continue Snubber Resistor Test

NOTE: K ohm = ohm reading multiplied by 1000.

NOTE: Always make sure that all four Switch Boards are changed at the same time. Never mix an old style (different part number) Switch Board with a new style (new part number).

Return to Section TOC
Return to Master TOC

FIELD EFFECT TRANSISTOR/SWITCH BOARD TEST *(continued)*

TABLE F.5 – SWITCH BOARD 4 RESISTANCE TEST TABLE

Apply Positive Test Probe to Terminal	Apply Negative Test Probe to Terminal	Test Result	Conclusion	Repair Action	Next Procedure
4B	12D	Greater than 1K ohm Less than 100 ohms	OK Shorted	None Replace 4 Switch Boards	Continue Snubber Resistor Test
12D	4B	Less than 100 ohms Greater than 1K ohm	OK Open	None Replace 4 Switch Boards	Continue Snubber Resistor Test
9D	3B	Greater than 1K ohm Less than 100 ohms	OK Shorted	None Replace 4 Switch Boards	Continue Snubber Resistor Test
3B	9D	Less than 100 ohms Greater than 1K ohm	OK Open	None Replace 4 Switch Boards	Continue Snubber Resistor Test
4B	9D	Less than 100 ohms Greater than 1K ohm	OK Open	None Replace 4 Switch Boards	Continue Snubber Resistor Test
9D	4B	Greater than 1K ohm Less than 100 ohms	OK Shorted	None Replace 4 Switch boards	Continue Snubber Resistor Test

NOTE: K ohm = ohm reading multiplied by 1000.

NOTE: Always make sure that all four Switch Boards are changed at the same time. Never mix an old style (different part number) Switch Board with a new style (new part number).

Return to Section TOC
Return to Master TOC

FIELD EFFECT TRANSISTOR/SWITCH BOARD TEST *(continued)*

TABLE F.5 – SWITCH BOARD 4 RESISTANCE TEST TABLE *(Continued)*

Apply Positive Test Probe to Terminal	Apply Negative Test Probe to Terminal	Test Result	Conclusion	Repair Action	Next Procedure
12D	3B	Less than 100 ohms	OK	None	Continue
		Greater than 1K ohm	Open	Replace 4 Switch Boards	Snubber Resistor Test
3B	12D	Greater than 1K ohm	OK	None	Continue
		Less than 100 ohms	Shorted	Replace 4 Switch Boards	Snubber Resistor Test
12D	407	Greater than 1K ohm	OK	None	Continue
		Less than 100 ohms	Shorted	Replace 4 Switch Boards	Snubber Resistor Test
407	12D	Less than 100 ohms	OK	None	Continue
		Greater than 1K ohm	Open	Replace 4 Switch Boards	Snubber Resistor Test
9D	408	Less than 100 ohms	OK	None	Continue
		Greater than 1K ohm	Open	Replace 4 Switch Boards	Snubber Resistor Test
408	9D	Greater than 1K ohm	OK	None	Continue
		Less than 100 ohms	Shorted	Replace 4 Switch boards	Snubber Resistor Test

NOTE: K ohm = ohm reading multiplied by 1000.

NOTE: Always make sure that all four Switch Boards are changed at the same time. Never mix an old style (different part number) Switch Board with a new style (new part number).

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Return to Master TOC
Return to Section TOC
Return to Master TOC

IGBT/SWITCH BOARD TEST (G3165-1)

TABLE F.6 – NOTE: This test will NOT determine if an individual IGBT device is open.

Apply Positive Test Probe to Terminal	Apply Negative Test Probe to Terminal	Test Result	Conclusion	Repair Action	Next Procedure
2/4	12	Greater than 1k ohms	OK	None	Continue
		Less than 1K ohms	Shorted	Replace Switch Boards	Snubber Resistor Test
9	1/3	Greater than 1K ohms	OK	None	Continue
		Less than 1k ohms	Shorted	Replace Switch Boards	Snubber Resistor Test
2/4	9	Less than 100 ohms	OK	None	Continue
		Greater than 1k ohms	Open	Replace Switch Boards	Snubber Resistor Test
9	2/4	Greater than 1k ohms	OK	None	Continue
		Less than 1K ohms	Shorted	Replace Switch Boards	Snubber Resistor Test

NOTE: K ohm = ohm reading multiplied by 1000.

NOTE: Always make sure that all four Switch Boards are changed at the same time. Never mix an old style (different part number) Switch Board with a new style (new part number).

Return to Section TOC
Return to Master TOC

IGBT/SWITCH BOARD TEST (Continued)

TABLE F.6 (Continued)

Apply Positive Test Probe to Terminal	Apply Negative Test Probe to Terminal	Test Result	Conclusion	Repair Action	Next Procedure
12	1/3	Less than 100 ohms	OK	None	Continue
		Greater than 1K ohms	Open	Replace Switch Boards	Snubber Resistor Test
1/3	12	Greater than 1K ohms	OK	None	Continue
		Less than 1k ohms	Shorted	Replace Switch Boards	Snubber Resistor Test
12	401/403 405/407	Greater than 1K ohms	OK	None	Continue
		Less than 1k ohms	Shorted	Replace Switch Boards	Snubber Resistor Test
401/403 405/407	12	Less than 100 ohms	OK	None	Continue
		Greater than 1K ohms	Open	Replace Switch Boards	Snubber Resistor Test
9	402/404 406/408	Less than 100 ohms	OK	None	Continue
		Greater than 1K ohms	Open	Replace Switch Boards	Snubber Resistor Test
402/404 406/408	9	Greater than 1K ohms	OK	None	Continue
		Less than 1k ohms	Shorted	Replace Switch boards	Snubber Resistor Test

NOTE: K ohm = ohm reading multiplied by 1000.

NOTE: Always make sure that all four Switch Boards are changed at the same time. Never mix an old style (different part number) Switch Board with a new style (new part number).

SNUBBER AND BLEEDER RESISTOR TEST

⚠ WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-800-833-9353 (WELD).

TEST DESCRIPTION

This test will determine if the eight snubber resistors and two bleeder resistors are of the proper value and their associated leads intact.

MATERIALS NEEDED

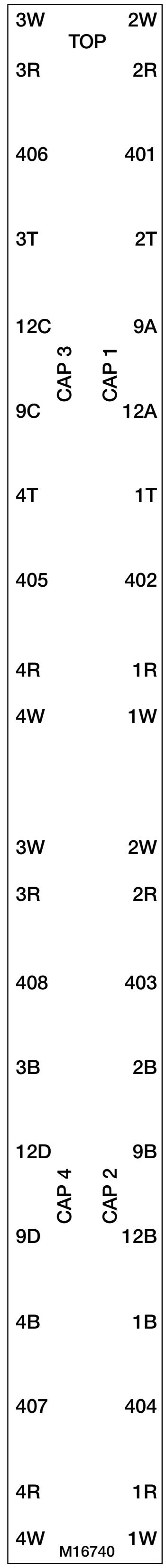
Volt/Ohmmeter (Multimeter)
5/16" Nut driver
3/8" Nut driver
Snubber and Bleeder Resistor Wiring Diagram – Figure F.25

This procedure takes approximately 30 minutes to perform.

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Return to Section TOC
Return to Master TOC

SNUBBER AND BLEEDER RESISTOR TEST

FIGURE F.24 - SWITCH BOARD ASSEMBLY CONNECTION DECAL



Return to Section TOC
Return to Master TOC

SNUBBER AND BLEEDER RESISTOR TEST *(continued)*

TEST PROCEDURE

1. Remove main input supply power to the machine.
2. With the 3/8" nut driver, remove the 4 screws that hold the handle to the machine.
3. Remove the rubber gasket (cover seal) from the lift bail.
4. With the 5/16" nut driver, remove the sheet metal screws from the case top.
5. With the 5/16" nut driver, remove the screws holding the right and left case sides. Remove the case sides by lifting up and out.
6. Perform the ***Capacitor Discharge Procedure*** described earlier in this section of the manual.

WARNING



Before continuing with the test procedure, perform the capacitor discharge procedure to avoid electric shock.

7. Perform the following tests on the four switch boards:

Switch Board 1: (Switch Board 1 is Marked CAP 1 on the Switch Board Assembly Connection Decal - See *Figure F.24.*)

A. Remove quick connect terminals #401, #402, #9, and #12 from switch board 1.

B. With the volt/ohmmeter, check for 25 ohms resistance between lead #401 and #12E.

If the measurement reads between 20 and 30 ohms, resistor R1 and leads #401 and #12E are okay. Go to step C.

If the measurement does not read between 20 and 30 ohms, check for continuity in leads #401 and #12E. Then test for 25 ohms resistance across R1 directly. If the measurement does not read between 20 and 30 ohms, replace resistor R1.

C. With the volt/ohmmeter, check for 25 ohms resistance between lead #402 and #9E.

If the measurement reads between 20 and 30 ohms, resistor R2 and leads #402 and #9E are okay. Go to step D.

If the measurement does not read between 20 and 30 ohms, check for continuity in leads #402 and #9E. Then test for 25 ohms resistance across R2 directly. If the measurement does not read between 20 and 30 ohms, replace resistor R2.

D. With the volt/ohmmeter, check for 7.5 K-ohms resistance between lead #12L (12E) and #9L (9E).

If the measurement reads between 6.75 and 8.25 K-ohms, resistor R9 and leads #12L(12E) and #9L (9E) are okay. Go to step E.

If the measurement does not read between 6.75 and 30 K-ohms, check for continuity in leads #12L (12E) and #9L(9E). Then test for 7.5 K-ohms resistance across R9 directly. If the measurement does not read between 6.75 and 8.25 K-ohms, replace resistor R9.

E. Reconnect quick connect terminals #401, #402, #9, and #12 on switch board 1.

Switch Board 2: (Switch Board 2 is Marked CAP 2 on the Switch Board Assembly Connection Decal - See *Figure F.24.*)

A. Remove quick connect terminals #403, #404, #9, and #12.

B. With the volt/ohmmeter, check for 25 ohms resistance between lead #403 and #12F.

If the measurement reads between 20 and 30 ohms, resistor R3 and leads #403 and #12F are okay. Go to step C.

If the measurement does not read between 20 and 30 ohms, check for continuity in leads #403 and #12F. Then test for 25 ohms resistance across R3 directly. If the measurement does not read between 20 and 30 ohms, replace resistor R3.

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SNUBBER AND BLEEDER RESISTOR TEST *(continued)*

C. With the volt/ohmmeter, check for 25 ohms resistance between lead #404 and #9F.

If the measurement reads between 20 and 30 ohms, resistor R4 and leads #404 and #9F are okay. Go to step D.

If the measurement does not read between 20 and 30 ohms, check for continuity in leads #404 and #9F. Then test for 25 ohms resistance across R4 directly. If the measurement does not read between 20 and 30 ohms, replace resistor R4.

D. Reconnect quick connect terminals #403, #404, #9, and #12 on switch board 2.

Switch Board 3: (Switch Board 3 is Marked CAP 1 on the Switch Board Assembly Connection Decal - See *Figure F.24.*)

A. Remove quick connect terminals #405, #406, #9, and #12 from switch board 3.

B. With the volt/ohmmeter, check for 25 ohms resistance between lead #405 and #12G.

If the measurement reads between 20 and 30 ohms, resistor R5 and leads #405 and #12G are okay. Go to step C.

If the measurement does not read between 20 and 30 ohms, check for continuity in leads #405 and #12G. Then test for 25 ohms resistance across R5 directly. If the measurement does not read between 20 and 30 ohms, replace resistor R5.

C. With the volt/ohmmeter, check for 25 ohms resistance between lead #406 and #9G.

If the measurement reads between 20 and 30 ohms, resistor R6 and leads #406 and #9G are okay. Go to step D.

If the measurement does not read between 20 and 30 ohms, check for continuity in leads #406 and #9G. Then test for 25 ohms resistance across R5 directly. If the measurement does not read between 20 and 30 ohms, replace resistor R5.

D. With the volt/ohmmeter, check for 7.5 K-ohms resistance between lead #12G (12M) and #9G (9M).

If the measurement reads between 6.75 and 8.25 K-ohms, resistor R10 and leads #12G (12M) and #9G (9M) are okay. Go to step E.

If the measurement does not read between 6.75 and 30 K-ohms, check for continuity in leads #12G (12M) and #9G (9M). Then test for 7.5 K-ohms resistance across R10 directly. If the measurement does not read between 6.75 and 8.25 K-ohms, replace resistor R10.

E. Reconnect quick connect terminals #405, #406, #9, and #12 on switch board 3.

Switch Board 4: (Switch Board 4 is Marked CAP 4 on the Switch Board Assembly Connection Label - See *Figure F.24.*)

A. Remove quick connect terminals #407, #408, #9, and #12 from switch board 4.

B. With the volt/ohmmeter, check for 25 ohms resistance between lead #407 and #12H.

If the measurement reads between 20 and 30 ohms, resistor R7 and leads #407 and #12H are okay. Go to step C.

If the measurement does not read between 20 and 30 ohms, check for continuity in leads #407 and #12H. Then test for 25 ohms resistance across R3 directly. If the measurement does not read between 20 and 30 ohms, replace resistor R7.

C. With the volt/ohmmeter, check for 25 ohms resistance between lead #408 and #9H.

If the measurement reads between 20 and 30 ohms, resistor R8 and leads #408 and #9H are okay. Go to step D.

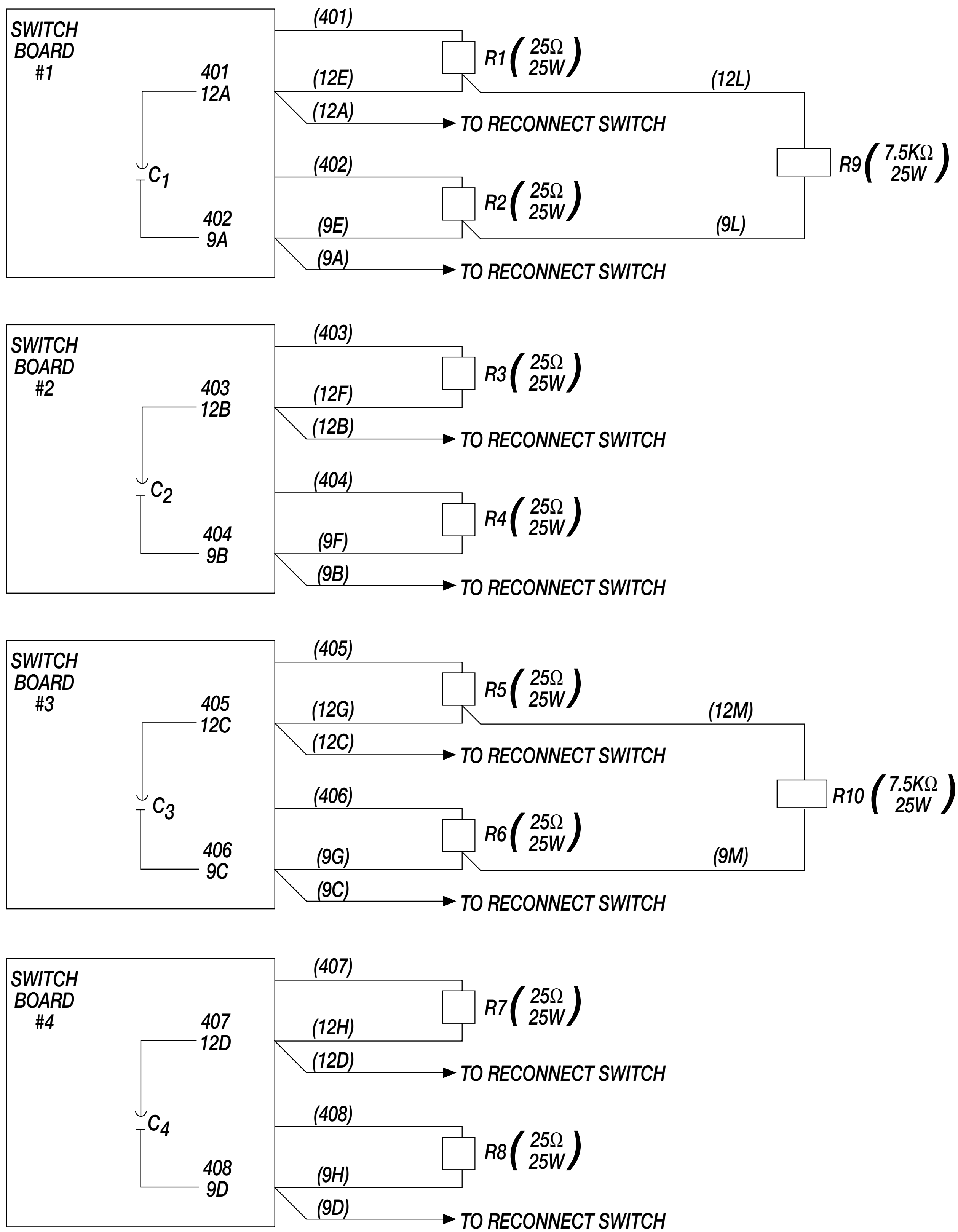
If the measurement does not read between 20 and 30 ohms, check for continuity in leads #408 and #9H. Then test for 25 ohms resistance across R8 directly. If the measurement does not read between 20 and 30 ohms, replace resistor R8.

D. Reconnect quick connect terminals #407, #408, #9, and #12 on switch board 4.

8. Install the machine case sides and top.

9. Install the handle and the lift bail rubber gasket.

FIGURE F.25 – SNUBBER AND BLEEDER RESISTOR WIRING DIAGRAM



NOTES

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Return to Master TOC

RECONNECT SWITCH TEST 1

⚠ WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-800-833-9353 (WELD).

TEST DESCRIPTION

This test will determine if there are any short circuits between the leads connected to the reconnect switch.

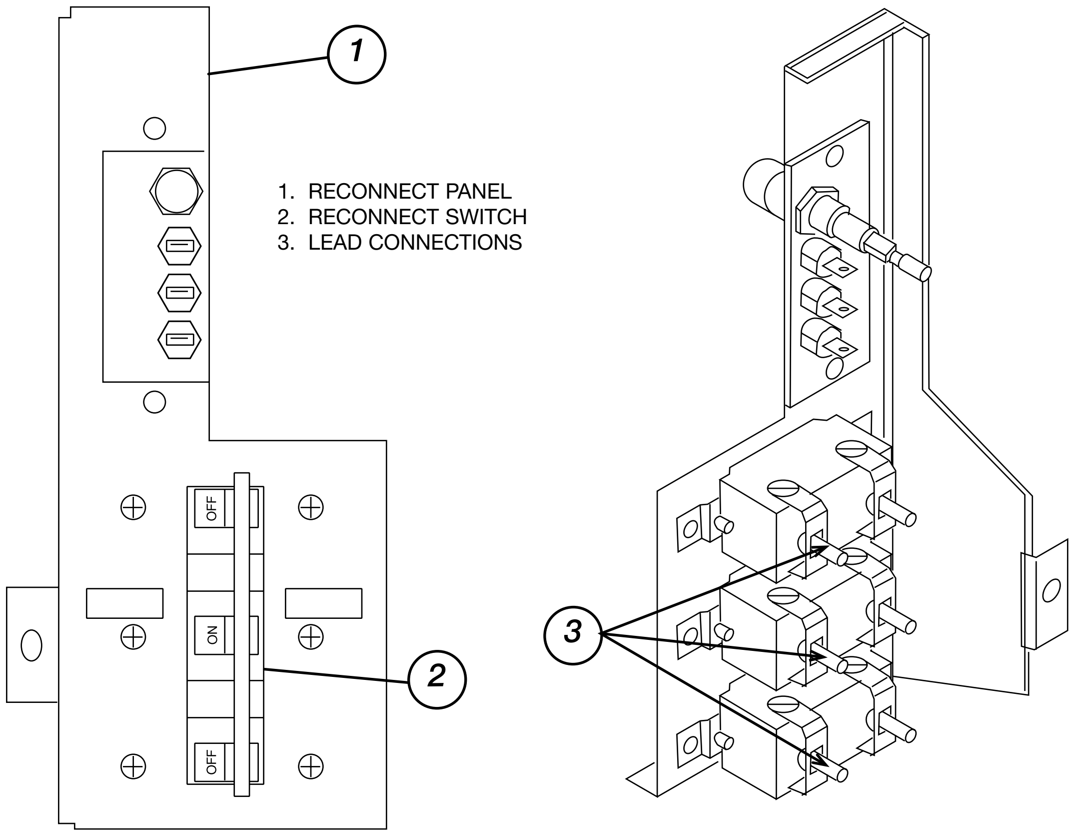
MATERIALS NEEDED

Volt/Ohmmeter (Multimeter)
5/16" Nut driver
3/8" Nut driver
Phillips head screw driver
Input and Reconnect Wiring Diagram – Figure F.27

This procedure takes approximately 40 minutes to perform.

RECONNECT SWITCH TEST 1

FIGURE F.26 - RECONNECT SWITCH



TEST PROCEDURE

1. Remove main input supply power to the machine.
2. With the 3/8" nut driver, remove the 4 screws that hold the handle to the machine.
3. Remove the rubber gasket (cover seal) from the lift bail.
4. With the 5/16" nut driver, remove the sheet metal screws from the case top.
5. With the 5/16" nut driver, remove the screws holding the right and left case sides. Remove the case sides by lifting up and out.
6. Perform the ***Capacitor Discharge Procedure*** described earlier in this section of the manual.

WARNING



Before continuing with the test procedure, perform the capacitor discharge procedure to avoid electric shock.

7. Test the reconnect switch for short circuits according to the voltage for which the machine is wired:

For 230 VAC:

A. Check that the following leads are connected together at the reconnect switch: #9A, #9B, #9C, #9D, #9K, #9J, and POS.

B. Check that the following leads are connected together at the reconnect switch: #12A, #12B, #12C, #12D, #12K, #12J, and NEG.

C. With the volt/ohmmeter, check that there is no continuity between the two groups of leads in A and B above.

RECONNECT SWITCH TEST 1 *(continued)*

For 380 or 460 VAC:

A. Check that the following leads are connected together at the reconnect switch: #9A, #9B, #9K, and POS.

B. Check that the following leads are connected together at the reconnect switch: #9C, #9D, #9J, #12A, #12B, and #12J.

C. Check that the following leads are connected together at the reconnect switch: #12C, #12D, #12K and NEG.

D. With the volt/ohmmeter, check that there is no continuity between the three groups of leads in A, B, and C above.

8. If any of the leads tested above are shorted, go to step 9. If none of the leads are shorted, the test is complete. Install the machine case sides, top, handle and the lift bail rubber gasket.

9. Perform the following steps:

A. With the 5/16" nut driver, remove the screws that hold the PC board cover. Remove the cover.

B. Disconnect plug J31 from the protection board. If this eliminates the short, the protection board may be faulty. Replace the protection board. If the short persists, go to step 9C.

C. With the Phillips head screw driver, remove the POS and NEG leads from the reconnect switch. If this eliminates the short, either the input rectifier or the harness (leads POS and NEG) between the input rectifier and the reconnect switch is faulty. Check the harness and if it is not faulty, perform the Input Rectifier Test. Reconnect leads POS and NEG to the input rectifier. If the short persists, go to step 9D.

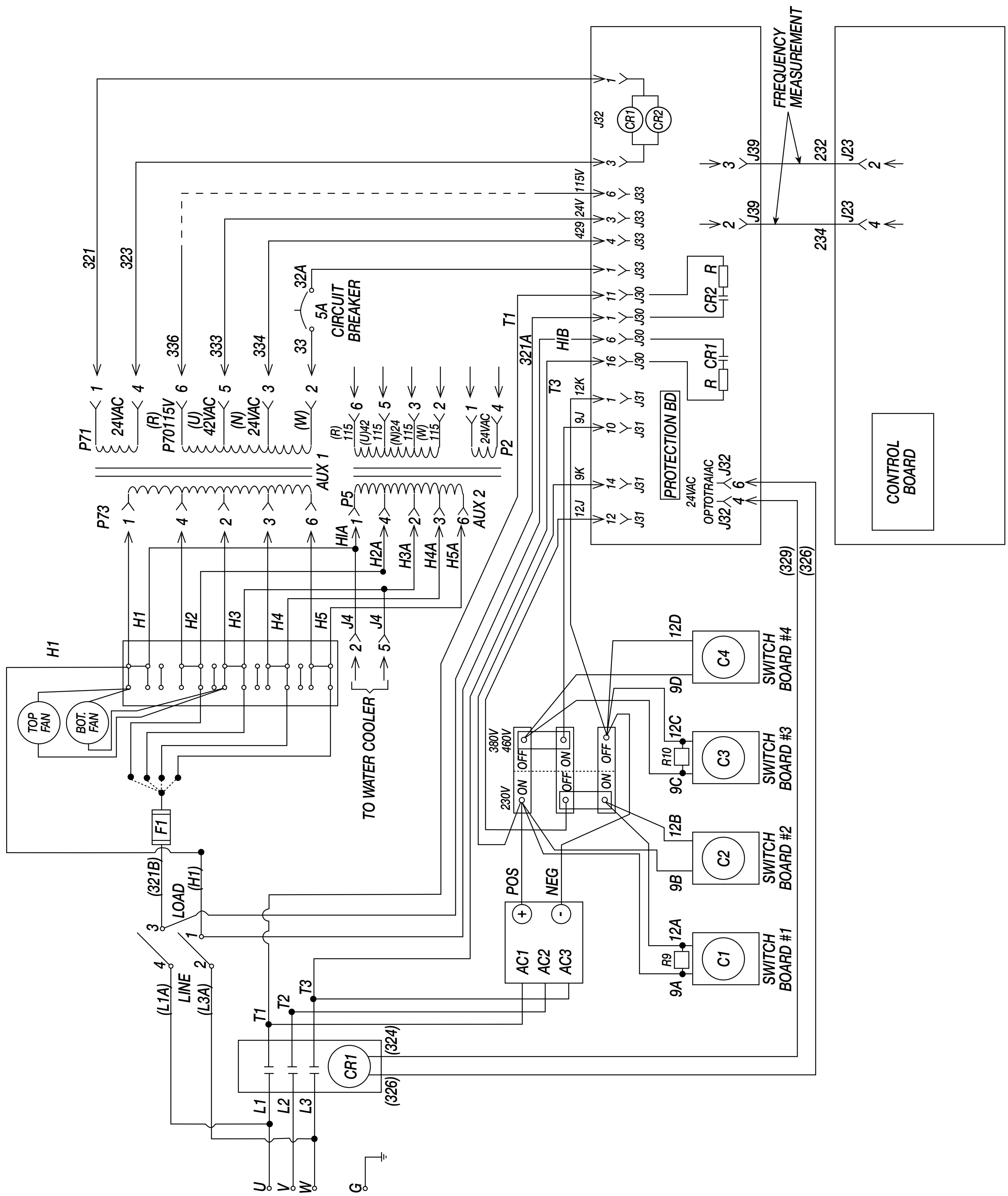
D. Remove leads #9A, #9B, #9C, #9D, #12A, #12B, #12C, and #12D from the four switch boards. If this eliminates the short, check these leads to make sure they are not exposed, damaged, or shorted. If the leads are okay, perform the ***Switch Board Test and the Snubber and Bleeder Resistor Test*** to find the cause of the short. Reconnect leads #9A, #9B, #9C, #9D, #12A, #12B, #12C, and #12D to the four switch boards before conduction these tests.

10. Replace the PC board cover and install the machine case sides and top.

11. Install the handle and the lift bail rubber gasket.

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FIGURE F.27 – INPUT AND RECONNECT WIRING DIAGRAM



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Return to Master TOC
Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC

RECONNECT SWITCH TEST 2

⚠ WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-800-833-9353 (WELD).

TEST DESCRIPTION

This test will determine if any leads connected to the reconnect switch are damaged.

MATERIALS NEEDED

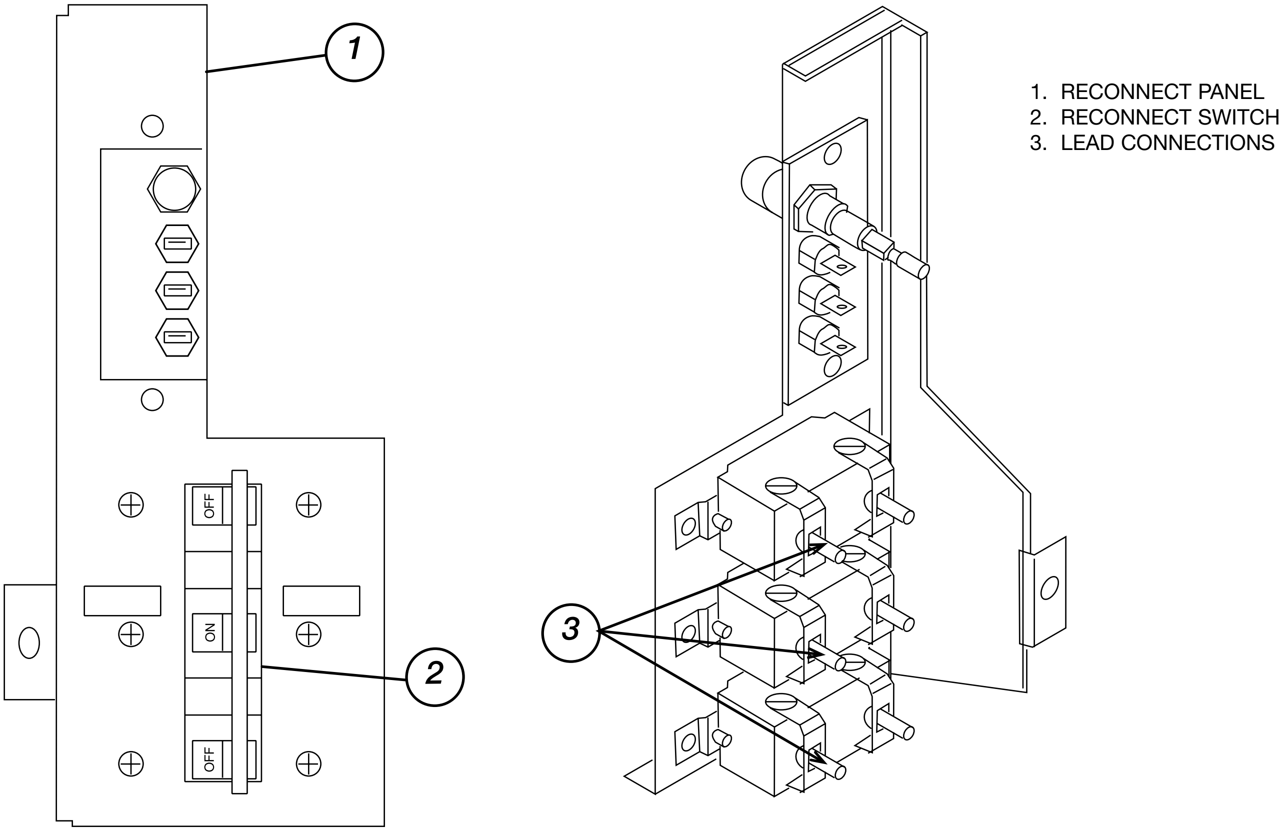
Volt/Ohmmeter (Multimeter)
5/16" Nut driver
3/8" Nut driver
Input and Reconnect Wiring Diagram – Figure F.29

This procedure takes approximately 40 minutes to perform.

Return to Section TOC
Return to Master TOC

RECONNECT SWITCH TEST 2 *(continued)*

FIGURE F.28 - RECONNECT SWITCH



TEST PROCEDURE

1. Remove main input supply power to the machine.
2. With the 3/8" nut driver, remove the 4 screws that hold the handle to the machine.
3. Remove the rubber gasket (cover seal) from the lift bail.
4. With the 5/16" nut driver, remove the sheet metal screws from the case top.
5. With the 5/16" nut driver, remove the screws holding the right and left case sides. Remove the case sides by lifting up and out.
6. Perform the ***Capacitor Discharge Procedure*** described earlier in this section of the manual.

WARNING



Before continuing with the test procedure, perform the capacitor discharge procedure to avoid electric shock.

7. Visually check that the following leads are not damaged or exposed. With the volt/ohmmeter, also test the leads for continuity:

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Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC

RECONNECT SWITCH TEST 2 *(continued)*

- Lead #9A between the reconnect switch and switch board #1.
- Lead #9B between the reconnect switch and switch board #2.
- Lead #9C between the reconnect switch and switch board #3.
- Lead #9D between the reconnect switch and switch board #4.
- Lead #9J between the reconnect switch and plug J31 - pin 10 of the protection board.
- Lead #9K between the reconnect switch and plug J31 - pin 14 of the protection board.

- Lead #12A between the reconnect switch and switch board #1.
- Lead #12B between the reconnect switch and switch board #2.
- Lead #12C between the reconnect switch and switch board #3.
- Lead #12D between the reconnect switch and switch board #4.
- Lead #12J between the reconnect switch and plug J31 - pin 12 of the protection board.
- Lead #12K between the reconnect switch and plug J31 - pin 1 of the protection board.

- Lead POS between the reconnect switch and the input rectifier.
- Lead NEG between the reconnect switch and the input rectifier.

8. With the volt/ohmmeter, test THAT THERE IS CONTINUITY between the leads in the following groups according to the voltage for which the machine is wired:

For 200-230 VAC:

A. Test for continuity between leads #9A, #9B, #9C, #9D, #9K, #9J, and POS connected together at the reconnect switch.

B. Test for continuity between leads #12A, #12B, #12C, #12D, #12K, #12J, and NEG connected together at the reconnect switch.

For 380 - 460 VAC:

A. Test for continuity between leads #9A, #9B, #9K, and POS connected together at the reconnect switch.

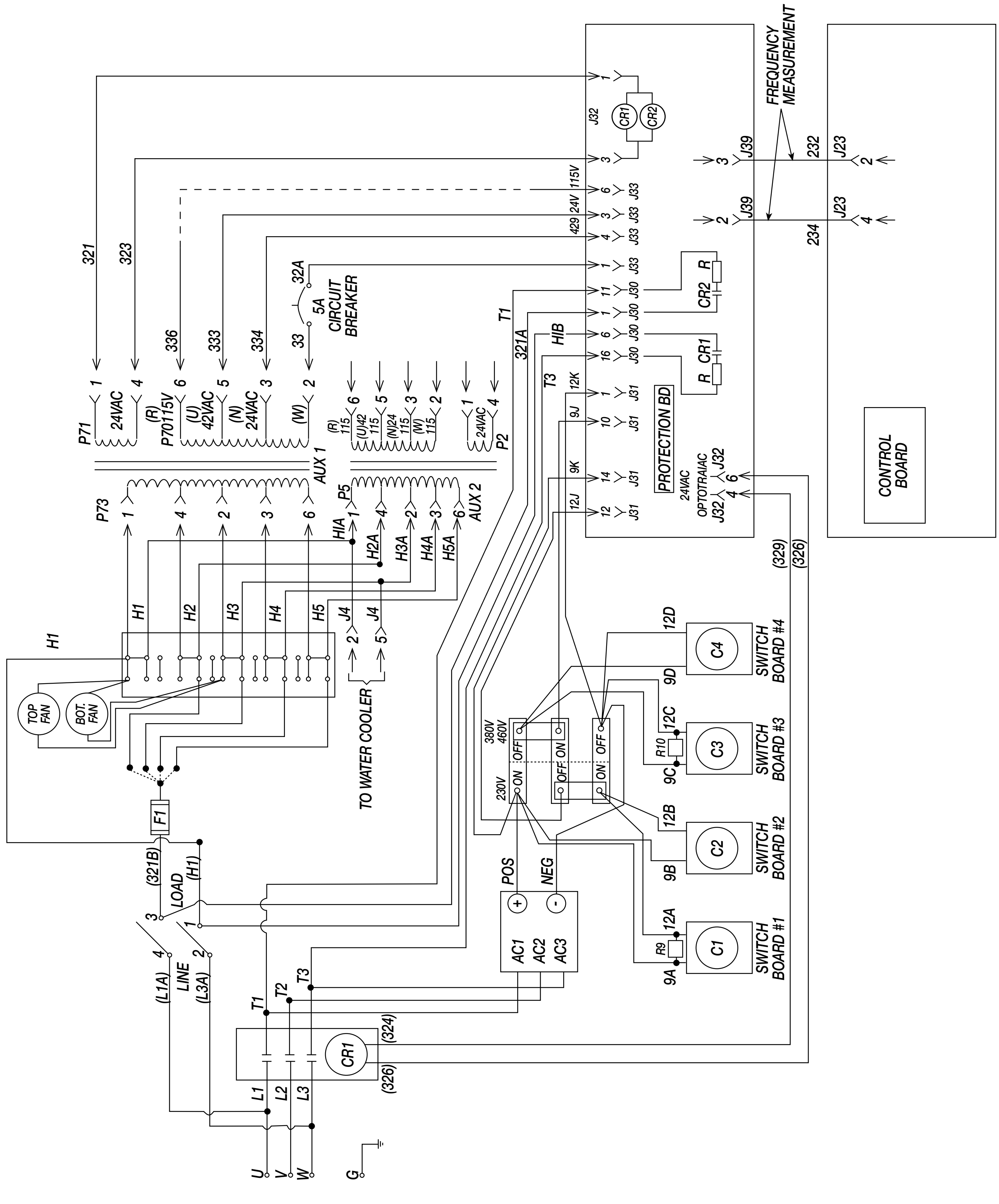
B. Test for continuity between leads #9C, #9D, #9J, #12A, #12B, and #12J connected together at the reconnect switch.

C. Test for continuity between leads #12C, #12D, #12K and NEG connected together at the reconnect switch.

9. If there is continuity within the groups of leads tested, the test is complete. Install the machine case sides, top, handle and the lift bail rubber gasket.

Return to Section TOC
Return to Master TOC
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Return to Section TOC
Return to Master TOC

FIGURE F.29 – INPUT AND RECONNECT WIRING DIAGRAM



STATIC CAPACITOR BALANCE TEST

⚠ WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-800-833-9353 (WELD).

TEST DESCRIPTION

This test will determine if, with no machine output, the input capacitors are balanced.

Before conducting this test, perform the following tests:

Switch Board Test - to ensure that none of the switch boards are faulty.

Snubber and Bleeder Resistance Test - to ensure that the bleeder resistors are properly connected to the switch boards.

Reconnect Switch Test 1 and Reconnect Switch Test 2 - to ensure that input power is properly connected to the switch boards.

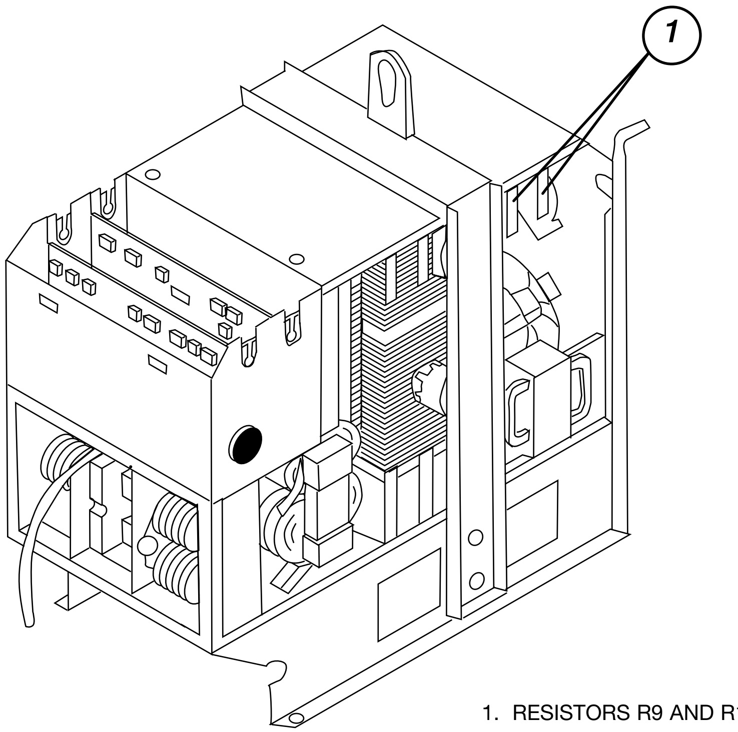
MATERIALS NEEDED

Volt/Ohmmeter (Multimeter)
5/16" Nut driver
3/8" Nut driver
Snubber and Bleeder Resistor Wiring Diagram – Figure F.31

This procedure takes approximately 30 minutes to perform.

STATIC CAPACITOR BALANCE TEST *(continued)*

FIGURE F.30 - BLEEDER RESISTORS R9 AND R10 LOCATION



1. RESISTORS R9 AND R10 (BLEEDER RESISTORS)

TEST PROCEDURE

1. Remove main input supply power to the machine.
2. With the 3/8" nut driver, remove the 4 screws that hold the handle to the machine.
3. Remove the rubber gasket (cover seal) from the lift bail.
4. With the 5/16" nut driver, remove the sheet metal screws from the case top.
5. With the 5/16" nut driver, remove the screws holding the right and left case sides. Remove the case sides by lifting up and out.
6. Perform the ***Capacitor Discharge Procedure*** described earlier in this section of the manual.

WARNING

Before continuing with the test procedure, perform the capacitor discharge procedure to avoid electric shock.

7. After you have completed the capacitor discharge procedure for all four switch boards, use the 5/16" nut driver to remove the two screws holding the PC board cover. Remove the cover.
8. If possible, set the machine up for 380 VAC or above by setting the reconnect switch and Jumper A to 380 VAC. If only 220 VAC is available, perform the test that way. Turn the machine on but have no output.

Return to Section TOC
Return to Master TOC
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Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC

STATIC CAPACITOR BALANCE TEST *(continued)*

⚠ WARNING



ELECTRIC SHOCK can kill.

With input supply power ON, there are high voltages inside the machine. Do not reach into the machine or touch any internal part of the machine, including resistors R9 and R10. Use insulated gloves to measure the resistance across these resistors.

---

9. Turn input supply power to the machine ON. Machine output must be OFF.
10. Measure and record the DC voltage across bleeder resistors R9 and R10. Compare the voltage recorded to the desired values in Table F.7, depending on the input supply voltage setup.
11. Determine the difference between the two bleeder resistor voltages.

For 380 VAC Input Voltage or Higher:

If the difference is less than 75 VDC, static capacitive balance is okay.

If the difference is more than 75 VDC, static capacitive balance is not okay. Perform the ***Input Rectifier Test***. Also visually check input filter capacitors C1, C2, C3, and C4 for any signs of damage; replace the FET or IGBT assembly.

For 220 VAC Input Voltage:

The two resistance measurements should be the same. If one or both is less than 175 VDC, perform the ***Main Contactor Test*** and the ***Input Rectifier Test***. Also visually check input filter capacitors C1, C2, C3, and C4 for any signs of damage; replace the FET or IGBT assembly.

12. After the test is completed and the problem successfully repaired, install the machine case sides and top.
13. Install the handle and the lift bail rubber gasket.

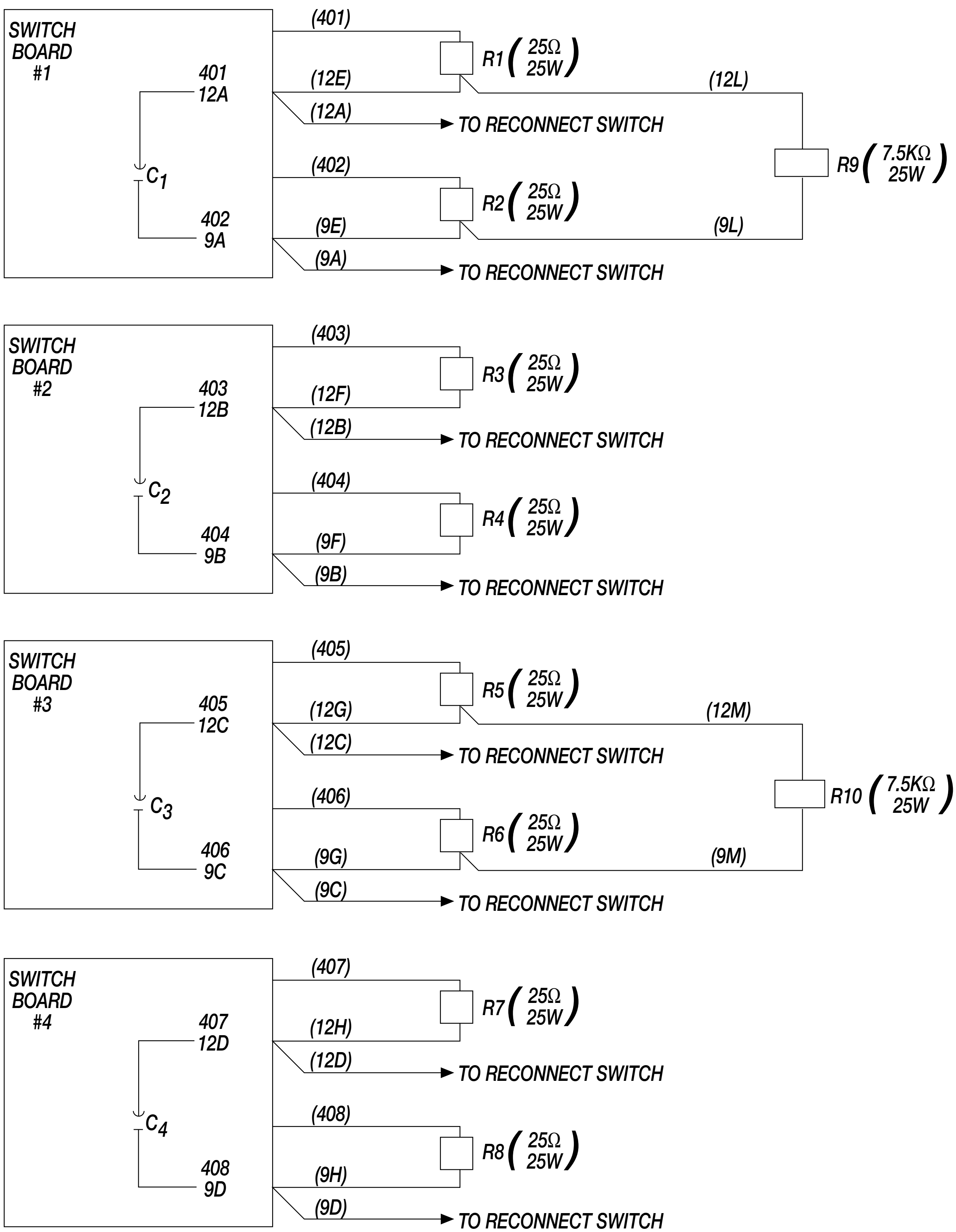
TABLE F.7
BLEEDER RESISTOR R9 AND R10 VOLTAGE VALUES

VAC INPUT	VDC ACROSS BLEEDER RESISTORS R9 AND R10
460 VAC	325 VDC
440 VAC	311 VDC
415 VAC	293 VDC
380 VAC	269 VDC
230 VAC	325 VDC
208 VAC	294 VDC

Return to Section TOC
Return to Master TOC

Figure F.31 – SNUBBER AND BLEEDER RESISTOR WIRING DIAGRAM

SNUBBER AND BLEEDER RESISTOR WIRING DIAGRAM



DYNAMIC CAPACITOR BALANCE TEST

WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-800-833-9353 (WELD).

TEST DESCRIPTION

This test will determine if, with no machine output, the control board is receiving the correct frequency signal from the protection board.

NOTE: Conduct this test after the Static Capacitor Balance Test has been performed successfully. The reconnect switch and Jumper A must be set for 380 VAC input voltage or higher. The selected input voltage must be the actual voltage applied.

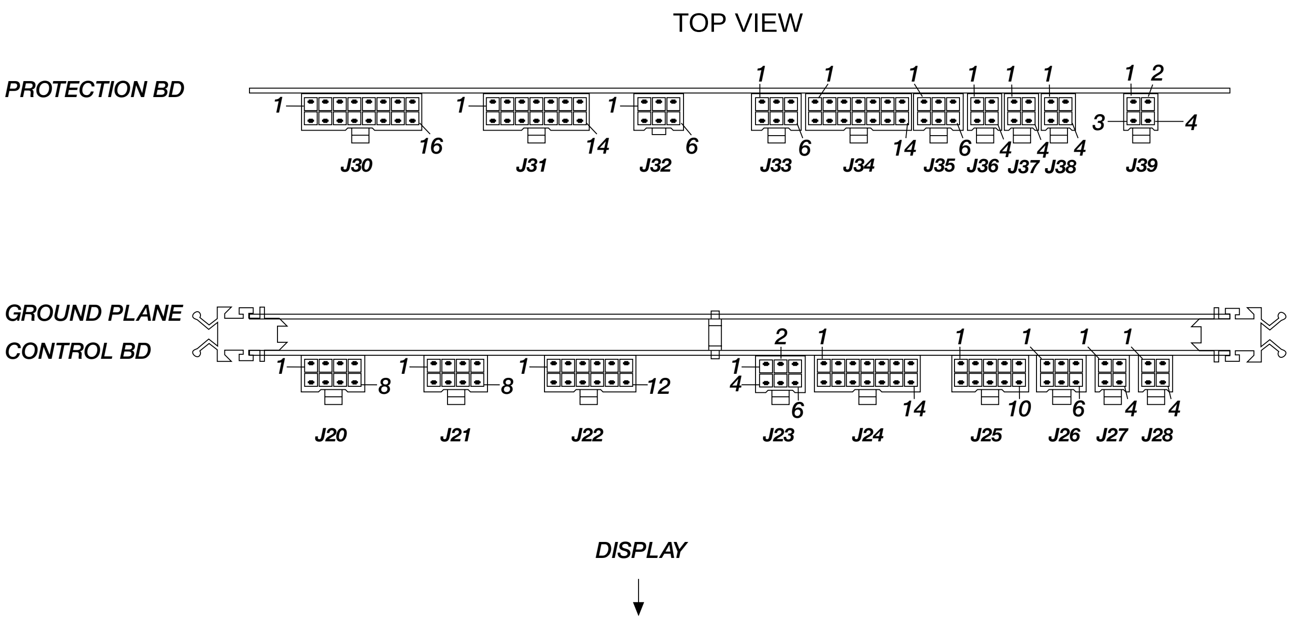
MATERIALS NEEDED

Volt/Ohmmeter (Multimeter)
Oscilloscope
5/16" Nut driver
3/8" Nut driver
Input and Reconnect Wiring Diagram – Figure F.33

This procedure takes approximately 45 minutes to perform.

DYNAMIC CAPACITOR BALANCE TEST *(continued)*

FIGURE F.32- CONTROL BOARD PLUG LOCATIONS



TEST PROCEDURE

1. Remove main input supply power to the machine.
2. With the 3/8" nut driver, remove the 4 screws that hold the handle to the machine.
3. Remove the rubber gasket (cover seal) from the lift bail.
4. With the 5/16" nut driver, remove the sheet metal screws from the case top.
5. With the 5/16" nut driver, remove the screws holding the right and left case sides. Remove the case sides by lifting up and out.
6. Perform the ***Capacitor Discharge Procedure*** described earlier in this section of the manual.

WARNING

Before continuing with the test procedure, perform the capacitor discharge procedure to avoid electric shock.

7. After you have completed the capacitor discharge procedure for all four switch boards, use the 5/16" nut driver to remove the two screws that hold the PC board cover. Remove the cover.
8. Connect the machine negative (-) output terminal to earth ground. Connect the oscilloscope case ground to earth ground.
9. Connect the oscilloscope to plug J23 - pin 4 (positive side) and plug J23 - pin 2 (negative side) on the control board. See Figure F.32 for location If these connections are reversed, you will not be able to see the frequency train on the oscilloscope. Set the oscilloscope to be DC coupled with 2 volts/division and 0.2 milliseconds/division.

Return to Section TOC
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Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC

DYNAMIC CAPACITOR BALANCE TEST *(continued)*

⚠ WARNING



ELECTRIC SHOCK can kill.

With input power ON, there are high voltages inside the machine, including the protection board. Do not reach into the machine or touch any internal part of the machine while power is ON.

10. Turn input power ON. Machine output must be OFF.

11. Measure the frequency between J23 - pin 4 and J23 - pin 2 on the control board. You should see between 3.2 and 5.3 divisions per cycle (950 to 1550 Hz.). If you do see this, the test is completed. If you do not see this, go to the next step.

12. Turn the power switch SW1 to the OFF position, disconnect input power to the machine, and perform the ***Capacitor Discharge Procedure***.

⚠ WARNING

Before continuing with the test procedure, perform the capacitor discharge procedure to avoid electric shock.

13. After you have completed the capacitor discharge procedure for all four switch boards, with the volt/ohmmeter, test leads 9J, 9K, 12J, and 12K for continuity between the between the reconnect switch and the protection board.

14. Test leads #232 and #234 for continuity. These leads are between the protection board and the control board. Lead #232 is between J39 - pin 3 and J23 - pin 2. Lead #234 is between J39 - pin 2 and J23 - pin 4. These leads must be intact for the frequency signal to be measured, because the transistor side of the optocoupler needs the power from the control board.

15. If all the leads tested in step 14 are okay, make sure that the molex plugs are all plugged in correctly and pushed far enough into their headers. Check the frequency again on the oscilloscope.

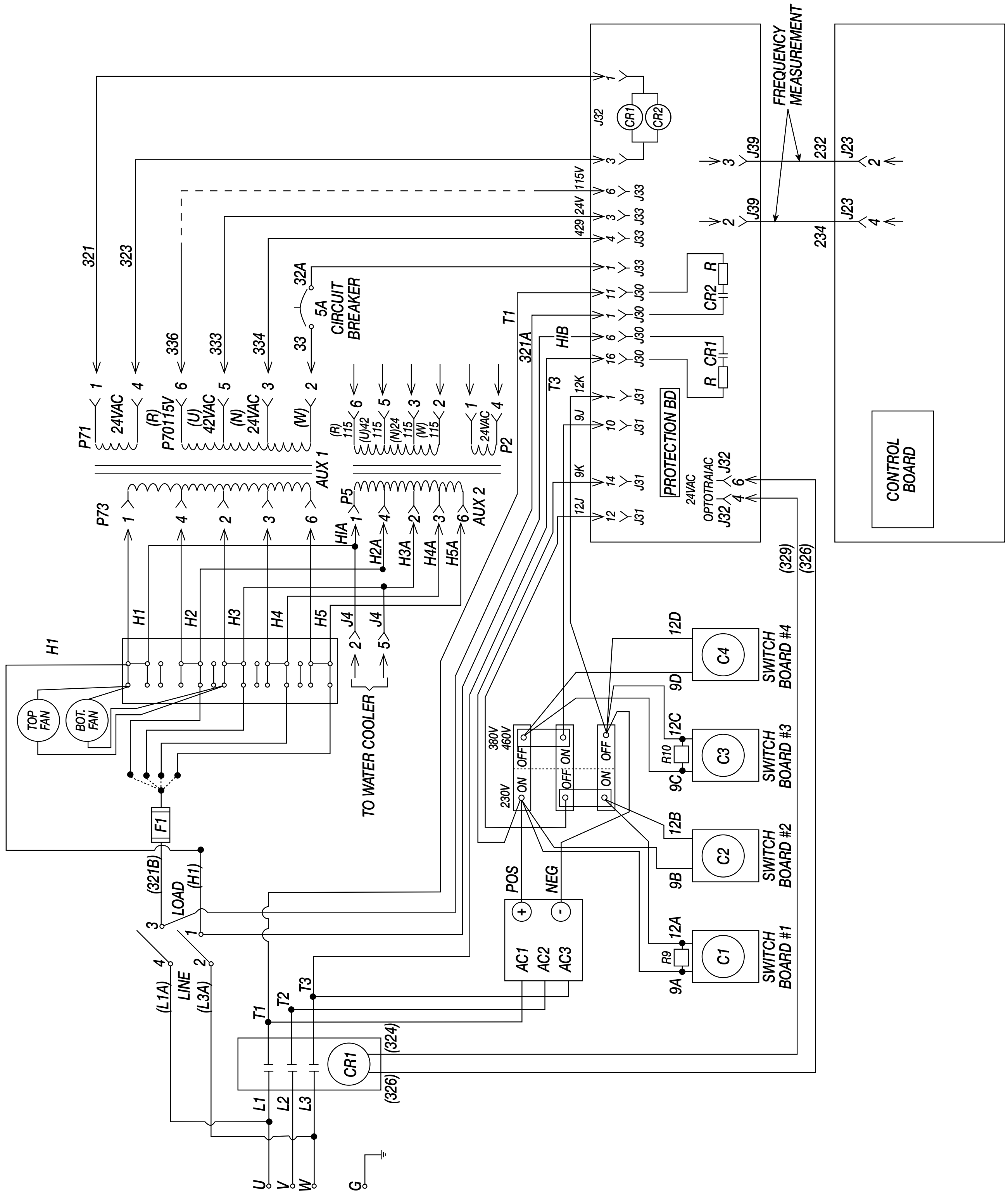
16. If the frequency is still incorrect, the protection board may be faulty. Replace the protection board and perform the ***Dynamic Capacitor Balance Test*** again.

17. If the frequency is still incorrect, the control board may be faulty. Replace the control board.

18. Install the machine case sides and top.

19. Install the handle and the lift bail rubber gasket.

FIGURE F.33 – INPUT AND RECONNECT WIRING DIAGRAM



Return to Section TOC
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Return to Master TOC
Return to Section TOC
Return to Master TOC

INTERNAL AND AUXILIARY SUPPLY VOLTAGE TEST

WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-800-833-9353 (WELD).

TEST DESCRIPTION

This test will determine if the proper voltages are present at the protection board, the power board, the control board, and the display board.

MATERIALS NEEDED

Volt/Ohmmeter (Multimeter)
5/16" Nut driver
3/8" Nut driver
Internal Auxiliary Supply Wiring Diagram – Figure F.34

This procedure takes approximately 45 minutes to perform.

Return to Section TOC
Return to Master TOC
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Return to Master TOC
Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC

INTERNAL AND AUXILIARY SUPPLY VOLTAGE TEST *(continued)*

TEST PROCEDURE

1. Remove main input supply power to the machine.
2. With the 3/8" nut driver, remove the 4 screws that hold the handle to the machine.
3. Remove the rubber gasket (cover seal) from the lift bail.
4. With the 5/16" nut driver, remove the sheet metal screws from the case top.
5. With the 5/16" nut driver, remove the screws holding the right and left case sides. Remove the case sides by lifting up and out.
6. Perform the ***Capacitor Discharge Procedure*** described earlier in this section of the manual.

⚠ WARNING

Before continuing with the test procedure, perform the capacitor discharge procedure to avoid electric shock.

7. After you have completed the capacitor discharge procedure for all four switch boards, remove the PC board cover. Use the 5/16" nut driver.
8. Remove the 5 leads (3 heavy and 2 small) T1, T2, T3 from main input contactor CR1. This is a safety precaution. It prevents high voltage from being put on the machine during the test. Wrap tape around the lead ends to insulate them and prevent them from touching.
9. Remove plug J30 from the protection board. See Figure F.1 for location of the board and plug J30.
10. Make sure that none of the pins are loose or open on the following molex plugs: J33, J34, J35, J37, J38 (on the protection board), J12, J13, J16 (on the display board), J22 (on the control board), J42, J43, and J44 (on the power board). See the Internal Auxiliary Supply Wiring Diagram, ***Figure F.34***.

⚠ WARNING



ELECTRIC SHOCK can kill.

With input power ON, there are high voltages inside the machine, including plug J30 and the protection board. Do not reach into the machine or touch any internal part of the machine while power is ON.

11. Turn input power ON. Machine output must be OFF.
12. Verify the following voltage measurements:

A. Protection Board:

115 VAC	Between J33 - pin 6 and J33 - pin 1 (Power Wave 450 only)
42 VAC	Between J33 - pin 3 and J33 - pin 1
24 VAC	Between J33 - pin 4 and J33 - pin 1

If any of these voltages are not present on the protection board, and the Auxiliary Transformer 1 Test has been completed successfully, do the following: Turn the power switch SW1 OFF and disconnect input power to the machine. Check the pins of plug J33 to be sure they are not loose or broken. Since Auxiliary Transformer 1 Test determined that voltages are present at plug J33, the fault must be that these signals are not getting to header J33.

B. Protection Board:

115 VAC	Between J34 - pin 1 and J34 - pin 5 (Power Wave 450 only)
42 VAC	Between J34 - pin 3 and J34 - pin 5
24 VAC	Between J34 - pin 4 and J34 - pin 5

If any of these voltages are not present on the protection board (and the voltages in part A, above, were present, replace the protection board.

INTERNAL AND AUXILIARY SUPPLY VOLTAGE TEST *(continued)*

C. Protection Board:

115 VAC	Between J34 - pin 8 and J34 - pin 12 (Power Wave 450 only)
42 VAC	Between J34 - pin 10 and J34 - pin 12
24 VAC	Between J34 - pin 11 and J34 - pin 12

If any of these voltages are not present on the protection board (and the voltages in part A, above, were present, replace the protection board.

D. Power Board:

42 VAC	Between J43 - pin 1 and J43 - pin 3

If this voltage is not present (and the voltages in part A, above, were present), disconnect plug J35 from the protection board and check for 42 VAC at header J35 between pin 1 and pin 6. If this voltage is NOT present, replace the protection board. If this voltage IS present, check the wiring between the boards. Then replace the power board.

E. Display Board:

+5 VDC	Between J16 - pin 2 and J16 - pin 3
+15 VDC	Between J16 - pin 10 and J16 - pin 7
+5 VDC	Between J16 - pin 1 and J16 - pin 7
-5 VDC	Between J16 - pin 9 and J16 - pin 7
-8 VDC	Between J16 - pin 6 and J16 - pin 7

If any of these voltages are not present (and the voltages in part D, above, were present), disconnect plug J44 from the power board and check the following voltages at header J44 on the power board:

+5 VDC	Between J44 - pin 3 and J44 - pin 2
+15 VDC	Between J44 - pin 10 and J44 - pin 12
+5 VDC	Between J44 - pin 11 and J44 - pin 12
-5 VDC	Between J44 - pin 9 and J44 - pin 12
-8 VDC	Between J44 - pin 6 and J44 - pin 12

If any of these voltages are NOT present, replace the power board. If these voltages ARE present, check the wiring first. Then replace the display board.

F. Control Board:

+15 VDC	Between J22 - pin 10 and J22 - pin 12
-15 VDC	Between J22 - pin 6 and J22- pin 12
+5 VDC	Between J22 - pin 11 and J22 - pin 12

If any of these voltages are not present (and the voltages in part D, above, were present), disconnect plug J42 from the power board and check the following voltages at header J42 on the power board:

+15 VDC	Between J42 - pin 10 and J42 - pin 12
-15 VDC	Between J42 - pin 6 and J42 - pin 12
+5 VDC	Between J42 - pin 11 and J42 - pin 12

If any of these voltages are NOT present, replace the power board. If these voltages ARE present, check the wiring. Then replace the control board.

Return to Section TOC
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Return to Section TOC
Return to Master TOC

INTERNAL AND AUXILIARY SUPPLY VOLTAGE TEST *(continued)*

13. With the Volt/ohmmeter, check the following leads for continuity:

A. Between the Protection Board and Wire Feeder 2 Receptacle:

Lead #32D	Between J34 - pin 5 and P82 - pin A
Lead #32E	Between J34 - pin 6 and P82 - pin I
Lead #42C	Between J34 - pin 3 and P82 - pin K
Lead #102D	Between J34 - pin 4 and P82 - pin C
Lead #31C	Between J34 - pin 1 and P82 - pin J
Lead #106A	Between J34 - pin 7 and P82 - pin D

B. Between the Protection Board and Wire Feeder 1 Receptacle:

Lead #32B	Between J34 - pin 12 and P83 - pin A
Lead #32C	Between J34 - pin 13 and P83 - pin I
Lead #42B	Between J34 - pin 10 and P83 - pin K
Lead #102B	Between J34 - pin 11 and P83 - pin C
Lead #31B	Between J34 - pin 8 and P83 - pin J
Lead #105A	Between J34 - pin 14 and P83 - pin D

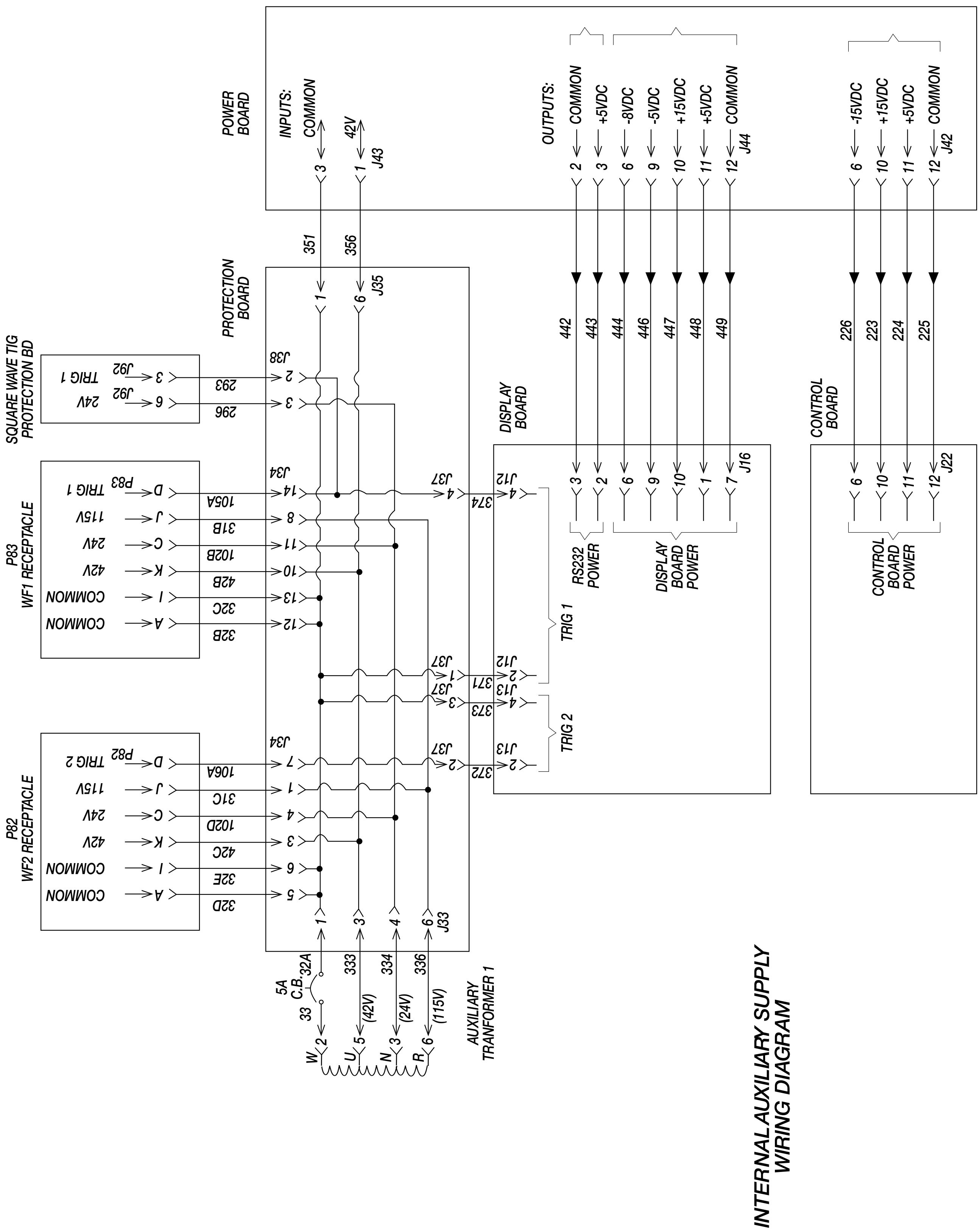
C. Between the protection board and the square wave TIG protection board:

Lead #296	Between J38 - pin 3 and J92 - pin 6

14. After the test is completed and the problem successfully repaired, disconnect input power to the machine.
15. Connect the five leads to main input contactor CR1 and insert plug J30 into the protection board.
16. Install the machine case sides and top.
17. Install the handle and the lift bail rubber gasket.

Return to Section TOC
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Return to Master TOC

FIGURE F.34 – INTERNAL AUXILIARY SUPPLY WIRING DIAGRAM



LINCOLN ELECTRIC

NOTES

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Return to Master TOC

MAIN CONTACTOR TEST

⚠ WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-800-833-9353 (WELD).

TEST DESCRIPTION

This test will determine if main input contactor CR1 and its associated wiring and components are faulty or damaged.

MATERIALS NEEDED

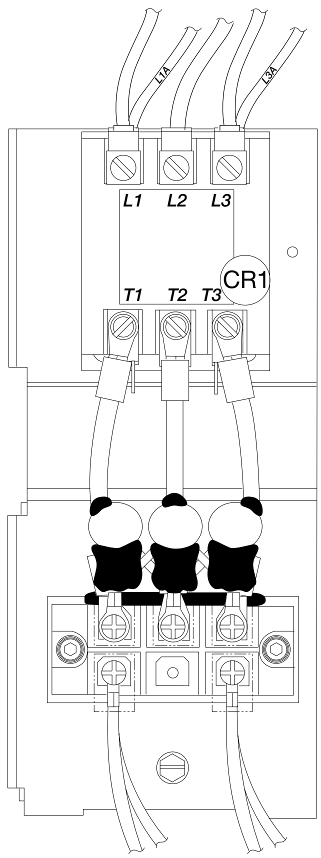
Volt/Ohmmeter (Multimeter)
5/16" Nut driver
3/8" Nut driver
Slot head screw driver
Input and Reconnect Wiring Diagram – Figure F.36

This procedure takes approximately 45 minutes to perform.

Return to Section TOC
Return to Master TOC

MAIN CONTACTOR TEST *(continued)*

FIGURE F.35 - MAIN CONTACTOR



TEST PROCEDURE

1. Remove main input supply power to the machine.
2. With the 3/8" nut driver, remove the 4 screws that hold the handle to the machine.
3. Remove the rubber gasket (cover seal) from the lift bail.
4. With the 5/16" nut driver, remove the sheet metal screws from the case top.
5. With the 5/16" nut driver, remove the screws holding the right and left case sides. Remove the case sides by lifting up and out.
6. Perform the ***Capacitor Discharge Procedure*** described earlier in this section of the manual.

⚠ WARNING



Before continuing with the test procedure, perform the capacitor discharge procedure to avoid electric shock.

7. After you have completed the capacitor discharge procedure for all four switch boards, visually inspect the input terminals L1, L2, and L3 of the main contactor. Make sure they are not shorted together. If they are shorted, go to step 8. If they are not shorted, go to step 9.
8. With the slot head screw driver, remove leads L1A and L3A from the main contactor.

MAIN CONTACTOR TEST *(continued)*

A. With the power switch SW1 OFF, check to see if leads L1A and L3A are shorted together. If they are shorted, visually inspect the leads. If the leads are okay, then power switch SW1 is faulty and must be replaced.

B. Remove leads L1, L2, and L3 from the main contactor. Check if the terminals of the main contactor are still shorted. If they are, the main contactor is faulty and must be replaced. If the terminals are not shorted, the input lines themselves are shorted. Reconnect leads L1, L2, L3, L1A, and L3A to the main contactor.

9. Visually inspect terminals T1, T2, and T3 of the main contactor. Make sure they are not shorted together in any way. If they are not shorted, go to step 11. If they are shorted, go to step 10.

10. Remove leads T1, T2, and T3 from the main contactor.

A. Check if the terminals of the main contactor are still shorted. If they are, the main contactor is faulty and must be replaced.

B. Reconnect leads T1, T2, and T3 to the main contactor. Remove plug J30 from the protection board. Make sure that leads T1 and T3 of plug J30 between the main contactor and the protection board are not damaged, exposed, or shorted together. Check again for shorts across the contacts of the main contactor. If the terminals are not shorted now, the protection board is faulty. Replace the protection board.

C. Visually inspect leads T1, T2, and T3 between the main contactor and the input rectifier and between the main contactor and the protection board. If these leads are not damaged or exposed, then the input rectifier may be faulty and should be checked. Perform the ***Input Rectifier Test*** described in this section of the manual.

11. With the volt/ohmmeter, check for continuity between the following terminals of the main contactor:

L1 and T1
L2 and T2
L3 and T3

If any of these measurements shows continuity, replace the main contactor. If no continuity is shown, go to step 12.

12. Visually check the following leads for damage, then check for continuity as described:

Lead #324	Between the main contactor and plug J32 - pin 4 of the protection board
Lead #326	Between the main contactor and plug J32 - pin 6 of the protection board
Lead #321	Between plug J71 - pin 1 of auxiliary Transformer 1 and plug J32 - pin 1 of the protection board
Lead #323	Between plug J71 - pin 4 of auxiliary Transformer 1 and plug J32 - pin 3 of the protection board
Lead T1	Between the main contactor and the protection board plug J30 - pin 11
Lead T3	Between the main contactor and the protection board plug J30 - pin 16

Put the power switch SW1 in the ON position for the next two continuity tests:

Lead H1B	Between terminal L3 of the main contactor and plug J30 - pin 6 of the protection board
Lead #321A	Between terminal L1 of the main contactor and plug J30 - pin 1 of the protection board

Put the power switch SW1 in the OFF position.

Replace any broken or damaged leads discovered by these tests.

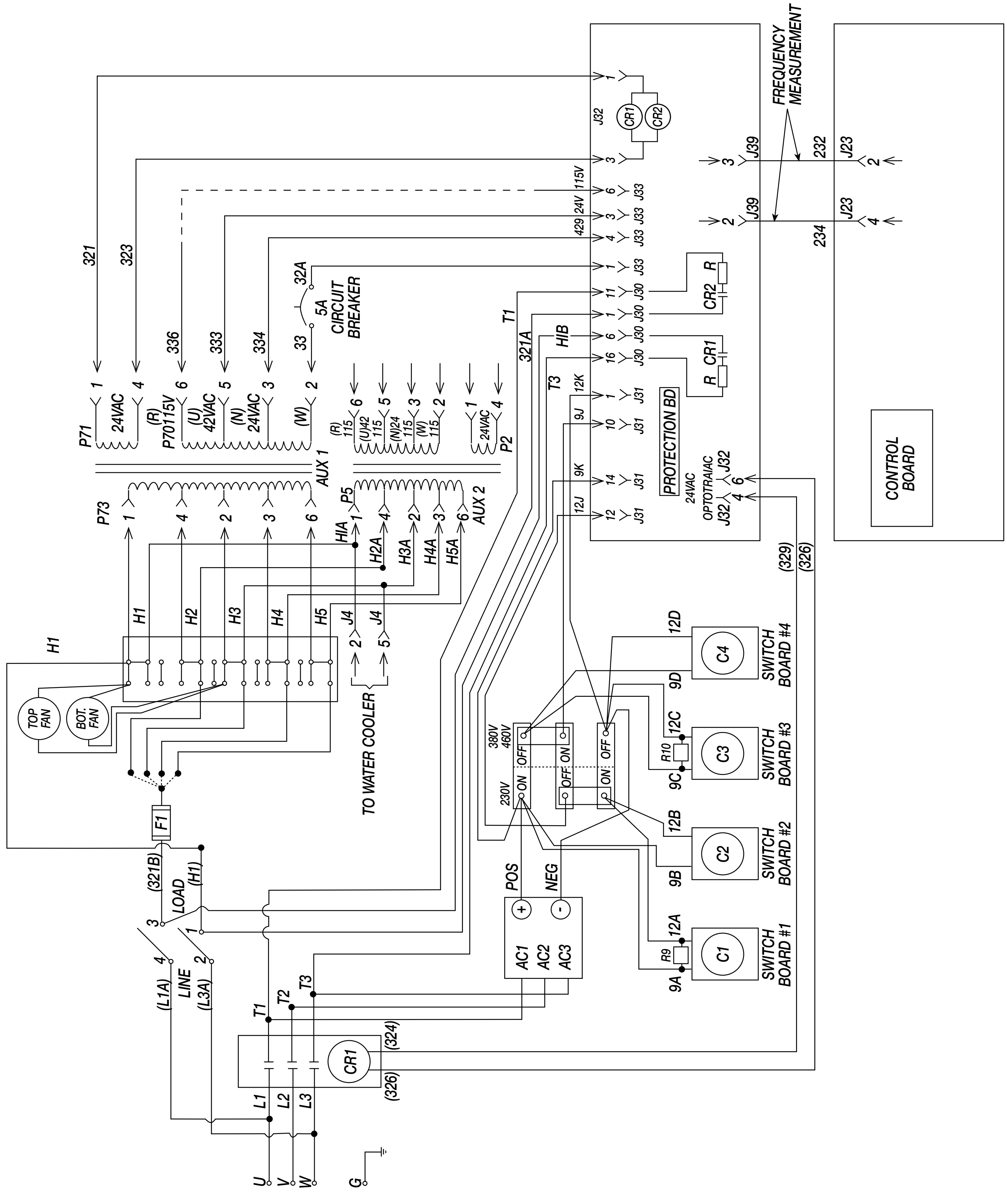
13. Connect any plugs disconnected for the tests. Replace the PC board cover with two sheet metal screws.

14. Install the machine case sides and top.

15. Install the handle and the lift bail rubber gasket.

Return to Section TOC
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Return to Section TOC
Return to Master TOC

FIGURE F.36 – INPUT AND RECONNECT WIRING DIAGRAM



SERIAL LOOP WIRING HARNESS TEST

WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-800-833-9353 (WELD).

TEST DESCRIPTION

This test will determine if there are any short circuits or other problems in the serial loop wiring between the power board, the control board, the display board, wire feeder 1 amphenol (P83) and wire feeder 2 amphenol (P82).

MATERIALS NEEDED

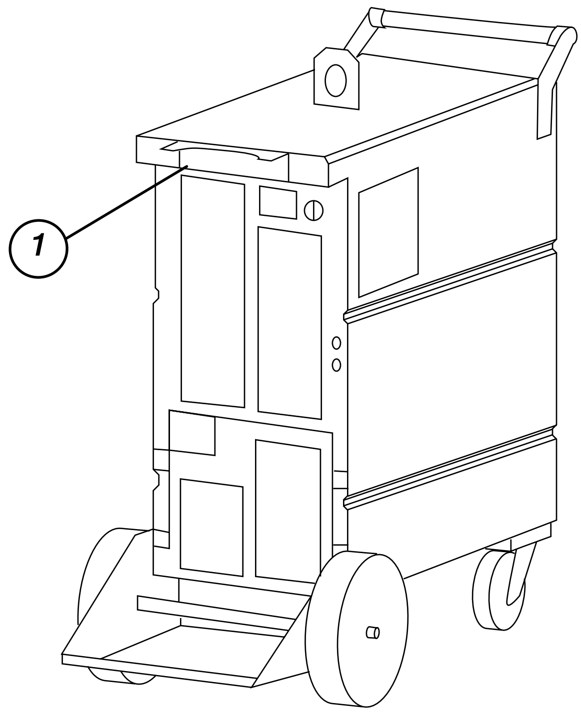
Volt/Ohmmeter (Multimeter)
5/16" Nut driver
3/8" Nut driver
Serial Loop Wiring Diagram Figure – F.38

This procedure takes approximately 30 minutes to perform.

Return to Section TOC
Return to Master TOC

SERIAL LOOP WIRING HARNESS TEST *(continued)*

FIGURE F.37 - WIRE FEEDER AMPHENOL LOCATIONS



1. WIRE FEEDER CONNECTIONS (ON BACK PANEL)

TEST PROCEDURE

1. Remove main input supply power to the machine.
2. With the 3/8" nut driver, remove the 4 screws that hold the handle to the machine.
3. Remove the rubber gasket (cover seal) from the lift bail.
4. With the 5/16" nut driver, remove the sheet metal screws from the case top.
5. With the 5/16" nut driver, remove the screws holding the right and left case sides. Remove the case sides by lifting up and out.
6. Perform the ***Capacitor Discharge Procedure*** described earlier in this section of the manual.

⚠ WARNING



Before continuing with the test procedure, perform the capacitor discharge procedure to avoid electric shock.

7. After you have completed the capacitor discharge procedure for all four switch boards, remove the PC board cover. Use the 5/16" nut driver.
8. Perform the following test for faults on the serial loop circuitry between wire feeder 1 amphenol (P83) and the control board.

A. Disconnect the wire feeder from the wire feeder 1 amphenol (P83).

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SERIAL LOOP WIRING HARNESS TEST *(continued)*

B. Check for loose or broken leads between the following pins:

P83 - pin L and J27 - pin 1 on the control board (lead #111A)

P83 - pin M and J27 - pin 4 on the control board (lead #112A)

C. Make sure that plug J27 is plugged into the control board securely and that none of its pins are loose.

D. Reconnect the wire feeder to the wire feeder 1 amphenol (P83).

9. Perform the following test for faults on the serial loop circuitry between wire feeder 2 amphenol (P82) and the control board.

A. Disconnect the wire feeder from the wire feeder 2 amphenol (P82).

B. Check for loose or broken leads between the following pins:

P82 - pin L and J28 - pin 1 on the control board (lead #117A)

P82 - pin M and J28 - pin 4 on the control board (lead #118A)

C. Make sure that plug J28 is plugged into the control board securely and that none of its pins are loose.

D. Reconnect the wire feeder to the wire feeder 2 amphenol (P82).

10. Perform the following test for faults on the serial loop circuitry between the display board and the control board.

A. Check for loose or broken leads between the following pins:

J26 - pin 3 on the control board and J14 - pin 6 on the display board (lead #263)

J26 - pin 4 on the control board and J14 - pin 3 on the display board (lead #264)

B. Make sure that plug J26 is plugged into the control board securely and that none of its pins are loose. Also make sure that plug J14 is securely plugged into the display board and that none of its pins are loose.

11. Perform the following test for faults on the serial loop circuitry 40 mA current supply.

A. Check for loose or broken leads between the following pins:

J22 - pin 5 on the control board and J44 - pin 5 on the power board (lead #5R)

J22 - pin 4 on the control board and J44 - pin 4 on the power board (lead #5W)

B. Make sure that plug J22 is plugged into the control board securely and that none of its pins are loose. Also make sure that plug J44 is securely plugged into the power board and that none of its pins are loose.

With the DC voltmeter, check for at least 30 VDC between plug J44 - pin 5 and pin 4 on the power board. This is the voltage source for the 40 mA current for the serial loop. If the voltage is low or not present, the power board may be faulty. Replace the power board.

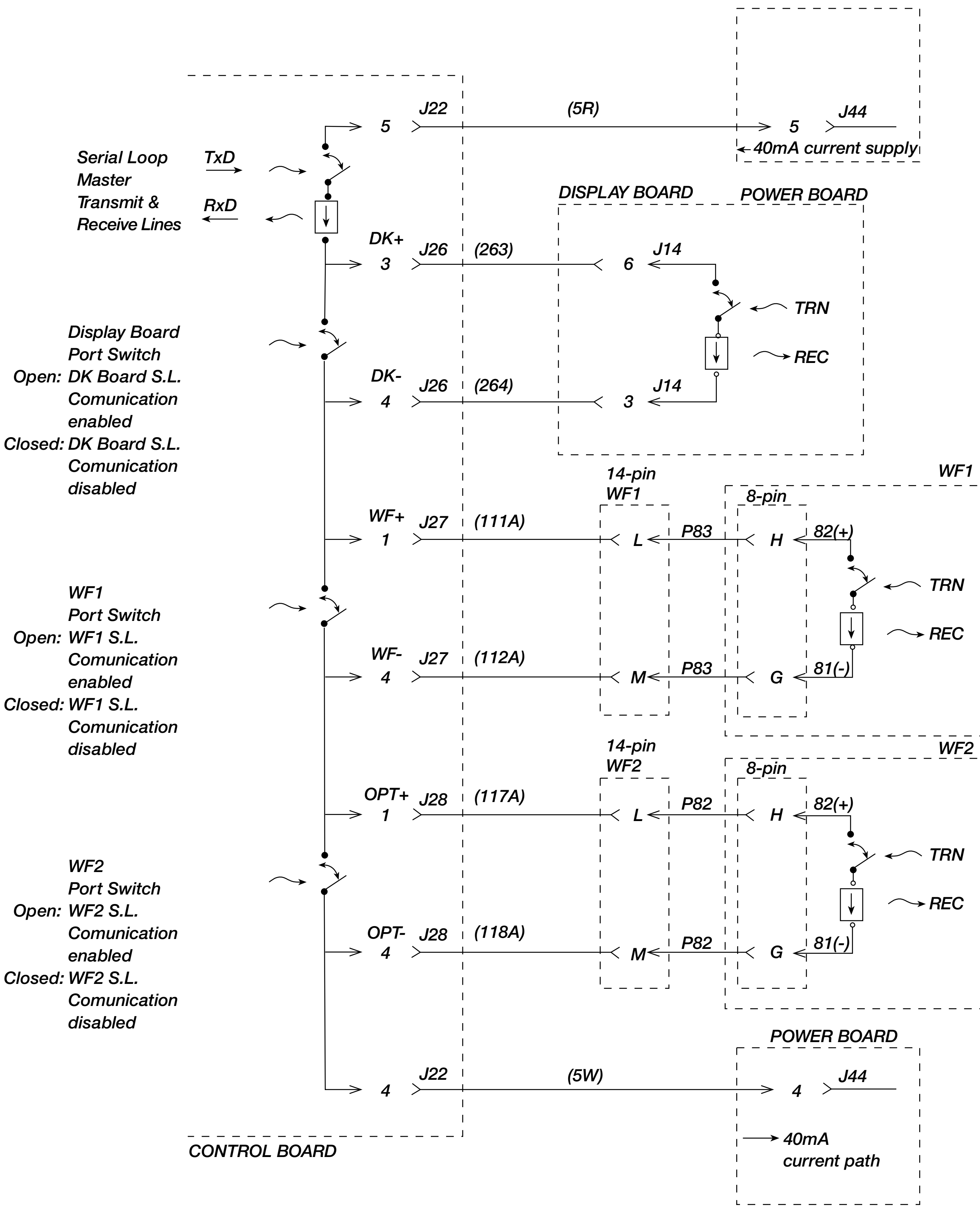
12. After the test is completed and the problem successfully repaired, replace the PC board cover with two sheet metal screws.

13. Install the machine case sides and top.

14. Install the handle and the lift bail rubber gasket.

Return to Section TOC
Return to Master TOC

FIGURE F.38 – SERIAL LOOP WIRING DIAGRAM



Return to Section TOC
Return to Master TOC

WIRE FEEDER 1 TRIGGER CIRCUIT TEST

WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-800-833-9353 (WELD).

TEST DESCRIPTION

This test will determine if there are any faults in the 24 VAC trigger circuit integral to the Power Wave and the wire feeder 1 amphenol (P83).

MATERIALS NEEDED

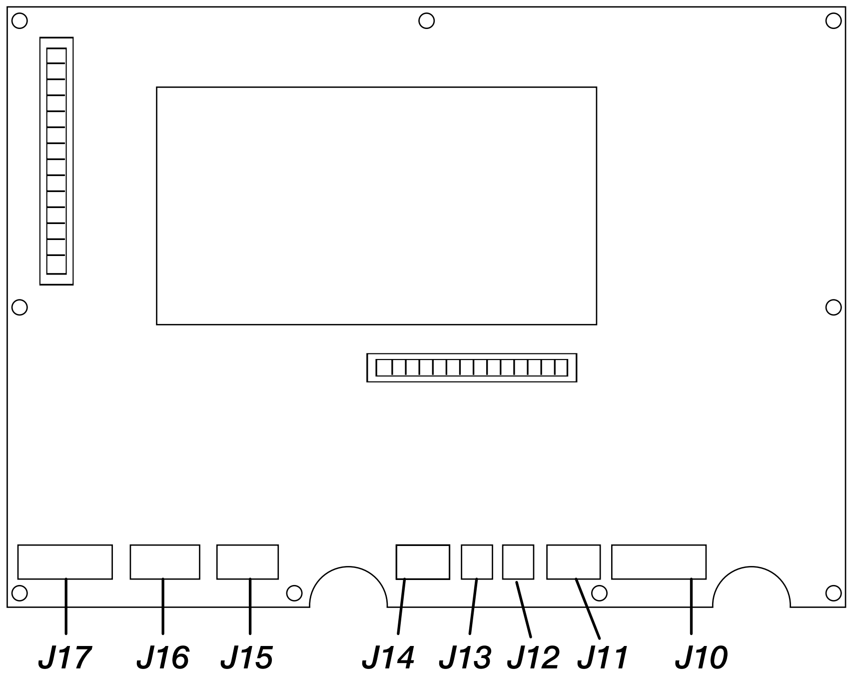
Volt/Ohmmeter (Multimeter)
5/16" Nut driver
3/8" Nut driver
Short piece of jumper wire
Trigger Circuit Wiring Diagram – Figure F.40

This procedure takes approximately 30 minutes to perform.

Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC

WIRE FEEDER 1 TRIGGER CIRCUIT TEST *(continued)*

FIGURE F.39 - DISPLAY BOARD PLUG LOCATIONS



TEST PROCEDURE

1. Remove main input supply power to the machine.
2. With the 3/8" nut driver, remove the 4 screws that hold the handle to the machine.
3. Remove the rubber gasket (cover seal) from the lift bail.
4. With the 5/16" nut driver, remove the sheet metal screws from the case top.
5. With the 5/16" nut driver, remove the screws holding the right and left case sides. Remove the case sides by lifting up and out.
6. Perform the ***Capacitor Discharge Procedure*** described earlier in this section of the manual.

WARNING



Before continuing with the test procedure, perform the capacitor discharge procedure to avoid electric shock.

7. After you have completed the capacitor discharge procedure for all four switch boards, remove the PC board cover. Use the 5/16" nut driver.
8. Remove plug J12 from the display board.
9. Place a jumper wire between pins C and D of wire feeder receptacle #1.
10. Remove the 5 leads (3 heavy and 2 small) T1, T2, T3 from main input contactor CR1. This is a safety precaution. It prevents high voltage from being put on the machine during the test. Wrap tape around the lead ends to insulate them and prevent them from touching.

Return to Section TOC
Return to Master TOC

WIRE FEEDER 1 TRIGGER CIRCUIT TEST *(continued)*

11. Remove plug J30 from the protection board. See ***Figure F.1*** for location of the board and plug J30.

⚠ WARNING



ELECTRIC SHOCK can kill.

With the input power ON, there are high voltages inside the machine. Do not reach into the machine or touch any internal parts.

12. Turn input power ON.
13. With the volt/ohmmeter, check for 24 VAC between plug J12 - pin 2 and pin 4.

A. If 24 VAC IS present, go to step 14.

NOTE: A voltage of 5 to 10 VDC is normal between these pins without the C to D jumper installed in the wirefeeder receptacle.

B. If 24 VAC is NOT present, check for 24 VAC between plug J33 - pin 4 and pin 1. See the Trigger Circuit Wiring Diagram, ***Figure F.40.***

C. If 24 VAC IS present between plug J33 pin 4 and pin 1, check the continuity and integrity of leads #371, 374, 102B, and 105A and their associated pin connectors. See the Trigger Circuit Wiring Diagram. If the continuity checks are good, the protection board may be faulty. Replace the protection board.

D. If 24 VAC is NOT present between plug J33 pin 4 and pin 1, check Auxiliary Transformer #1, the 5 amp circuit breaker, and the associated wiring. See the Trigger Circuit Wiring Diagram, ***Figure F.40.***

14. Turn input power to the machine OFF and perform the ***Capacitor Discharge Procedure.***
15. Remove plug J26 from the control board. Attach a 150 ohm resistor between plug J26 - pin 1 and J26 - pin 2 (the J26 plug, not the header on the control board).
16. Replace plug J12 into the display board.

⚠ WARNING

ELECTRIC SHOCK can kill.

With the input power ON, there are high voltages inside the machine, including the protection board. Do not reach into the machine or touch any internal parts.

17. Turn input power ON. The LCD display will read: ERROR: S.L. NOT INITIALIZED. Disregard this; the test can still be performed.
18. Remove the jumper between pins C and D of wire feeder #1 receptacle.
19. With the volt/ohmmeter, measure the voltage drop across the 150 ohm resistor between J26 - pins 1 and 2. With the jumper removed, the reading should be zero volts (NO voltage drop).
20. Replace the jumper between pins C and D of wire feeder #1 receptacle. Measure the voltage drop with the jumper installed. The reading should be about 2 VDC across the resistor.

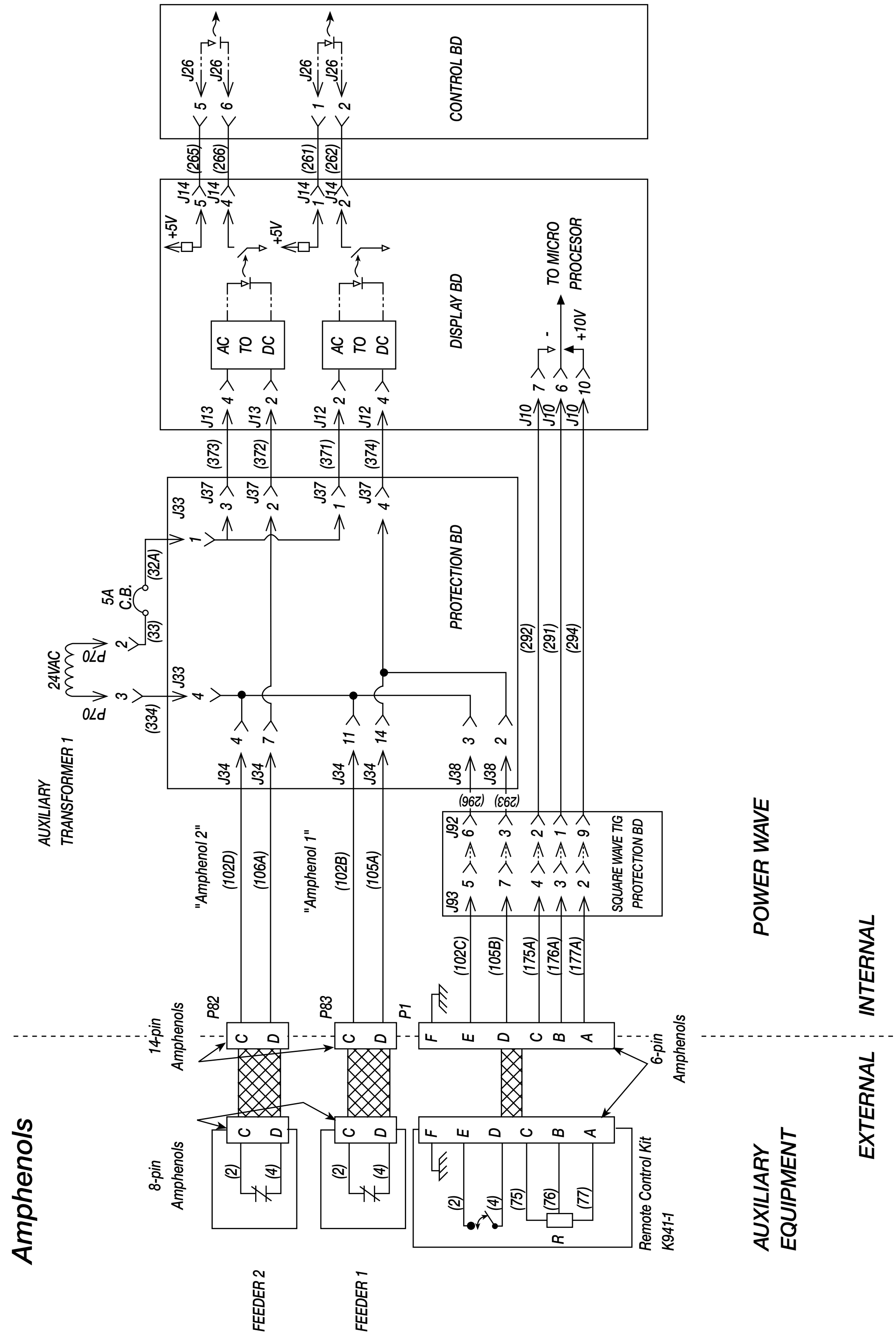
A. If 2 VDC is NOT present, check the continuity and integrity of leads #262 and 261 and their associated pins and connectors. The display board may be faulty -- replace the display board.

B. If 2 VDC IS present across the resistor, the control board may be faulty -- replace the control board.

21. Turn input power to the machine OFF and connect the five leads to the main contactor. Connect all molex plugs to the PC boards and replace the cover with two sheet metal screws. Install the machine case sides, top, handle, and lift bail rubber gasket.

Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC

FIGURE F.40 – TRIGGER CIRCUIT WIRING DIAGRAM



Return to Section TOC
Return to Master TOC

WIRE FEEDER 2 TRIGGER CIRCUIT TEST

WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-800-833-9353 (WELD).

TEST DESCRIPTION

This test will determine if there are any faults in the 24 VAC trigger circuit integral to the Power Wave and the wire feeder 2 amphenol (P82).

MATERIALS NEEDED

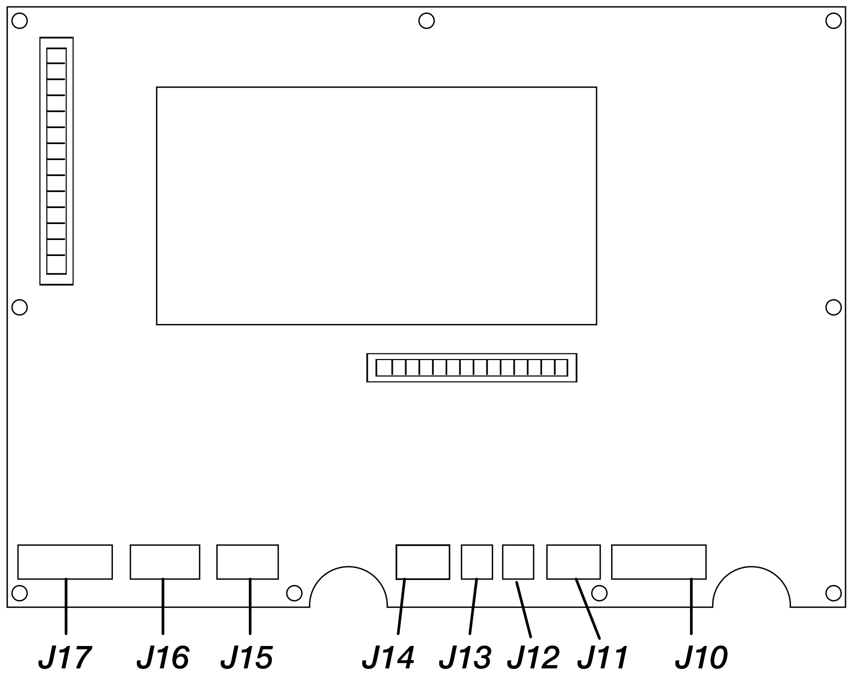
Volt/Ohmmeter (Multimeter)
5/16" Nut driver
3/8" Nut driver
Short piece of jumper wire
Trigger Circuit Wiring Diagram – Figure F.42.

This procedure takes approximately 30 minutes to perform.

Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC

WIRE FEEDER 2 TRIGGER CIRCUIT TEST *(continued)*

FIGURE F.41 - DISPLAY BOARD PLUG LOCATIONS



TEST PROCEDURE

1. Remove main input supply power to the machine.
2. With the 3/8" nut driver, remove the 4 screws that hold the handle to the machine.
3. Remove the rubber gasket (cover seal) from the lift bail.
4. With the 5/16" nut driver, remove the sheet metal screws from the case top.
5. With the 5/16" nut driver, remove the screws holding the right and left case sides. Remove the case sides by lifting up and out.
6. Perform the ***Capacitor Discharge Procedure*** described earlier in this section of the manual.

⚠ WARNING



Before continuing with the test procedure, perform the capacitor discharge procedure to avoid electric shock.

7. After you have completed the capacitor discharge procedure for all four switch boards, remove the PC board cover. Use the 5/16" nut driver.
8. Remove plug J13 from the display board.
9. Place a jumper wire between pins C and D of wire feeder receptacle #2.
10. Remove the 5 leads (3 heavy and 2 small) T1, T2, T3 from main input contactor CR1. This is a safety precaution. It prevents high voltage from being put on the machine during the test. Wrap tape around the lead ends to insulate them and prevent them from touching.

Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC

WIRE FEEDER 2 TRIGGER CIRCUIT TEST *(continued)*

11. Remove plug J30 from the protection board. See ***Figure F.1*** for location of the board and plug J30.

⚠ WARNING



ELECTRIC SHOCK can kill.

With the input power ON, there are high voltages inside the machine. Do not reach into the machine or touch any internal parts.

---

12. Turn input power ON.
13. With the volt/ohmmeter, check for 24 VAC between plug J13 - pin 2 and pin 4.

A. If 24 VAC IS present, go to step 14.

NOTE: A voltage of 5 to 10 VDC is normal between these pins without the C to D jumper installed in the wirefeeder receptacle.

B. If 24 VAC is NOT present, check for 24 VAC between plug J33 - pin 4 and pin 1. See the Trigger Circuit Wiring Diagram, ***Figure F.42.***

C. If 24 VAC IS present between plug J33 pin 4 and pin 1, check the continuity and integrity of leads #373, 372, 102D, and 106A and their associated pin connectors. See the Trigger Circuit Wiring Diagram. If the continuity checks are good, the protection board may be faulty. Replace the protection board.

D. If 24 VAC is NOT present between plug J33 pin 4 and pin 1, check Auxiliary Transformer #1, the 5 amp circuit breaker, and the associated wiring. See the Trigger Circuit Wiring Diagram, ***Figure F.42.***

14. Turn input power to the machine OFF and perform the ***Capacitor Discharge Procedure.***
15. Remove plug J26 from the Protection-Control board. Attach a 150 ohm resistor between plug J26 - pin 5 and J26 - pin 6 (the J26 plug, not the header on the control board).
16. Replace plug J13 into the display board,

⚠ WARNING

ELECTRIC SHOCK can kill.

With the input power ON, there are high voltages inside the machine, including the protection board. Do not reach into the machine or touch any internal parts.

---

17. Turn input power ON. The LCD display will read: ERROR: S.L. NOT INITIALIZED. Disregard this; the test can still be performed.
18. Remove the jumper between pins C and D of wire feeder #2 receptacle.
19. With the volt/ohmmeter, measure the voltage drop across the 150 ohm resistor between J26 - pins 1 and 2. With the jumper removed, the reading should be zero volts (NO voltage drop).
20. Replace the jumper between pins C and D of wire feeder #2 receptacle. Measure the voltage drop with the jumper installed. The reading should be about 2 VDC across the resistor.

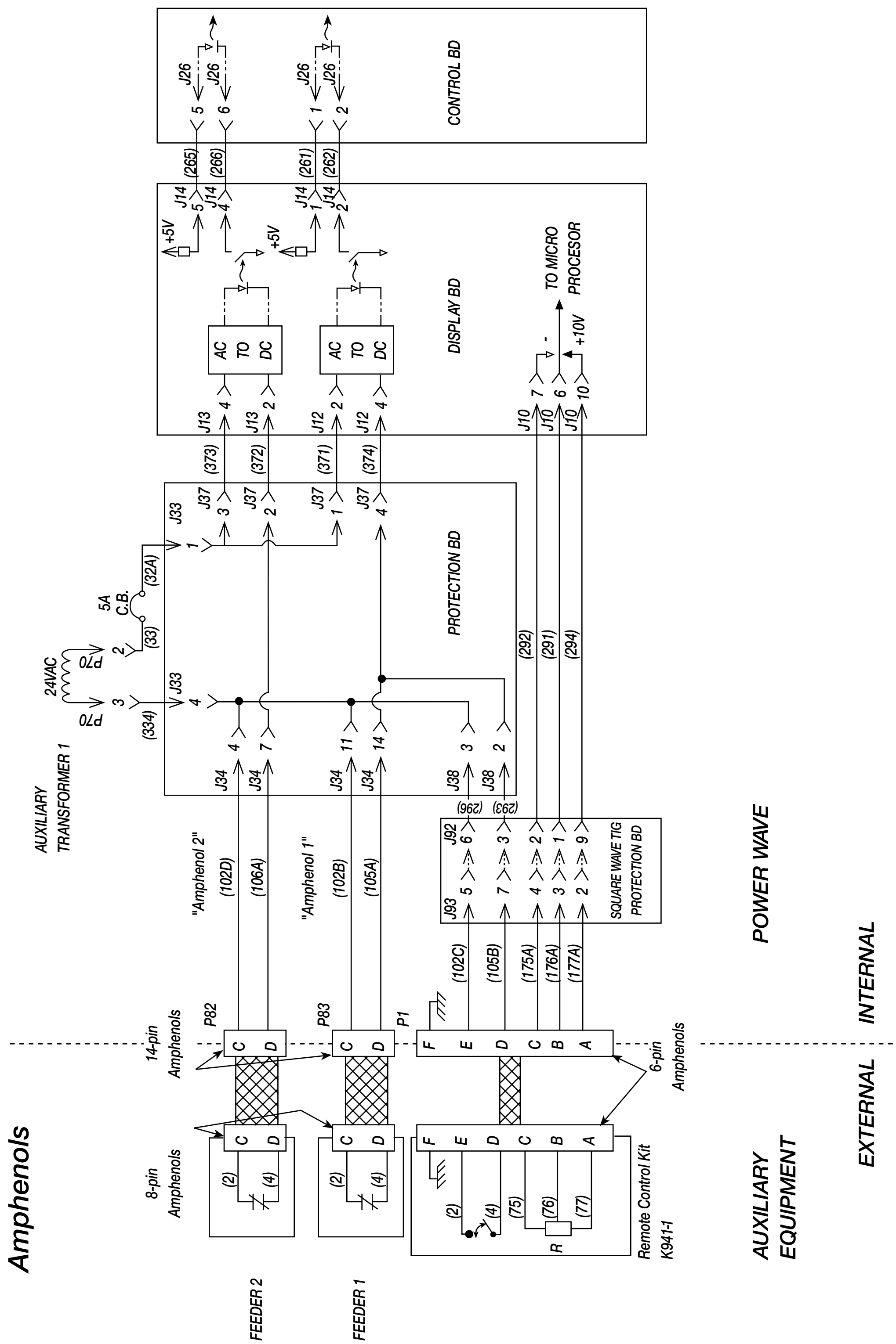
A. If 2 VDC is NOT present, check the continuity and integrity of leads #265 and 266 and their associated pins and connectors. The display board may be faulty -- replace the display board.

B. If 2 VDC IS present across the resistor, the control board may be faulty -- replace the control board.

21. Turn input power to the machine OFF and connect the five leads to the main contactor. Connect all molex plugs to the PC boards and replace the cover with two sheet metal screws. Install the machine case sides, top, handle, and lift bail rubber gasket.

Return to Section TOC Return to Master TOC

FIGURE F.42 – TRIGGER CIRCUIT WIRING DIAGRAM



Return to Section TOC
Return to Master TOC
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Return to Master TOC
Return to Section TOC
Return to Master TOC

TRIGGER CIRCUIT AND WIRING HARNESS TEST

⚠ WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-800-833-9353 (WELD).

TEST DESCRIPTION

This test will determine if there are any short circuits or other problems in the trigger circuit wiring or if there are any faulty PC boards, which would cause the 5 amp circuit breaker to trip repeatedly.

MATERIALS NEEDED

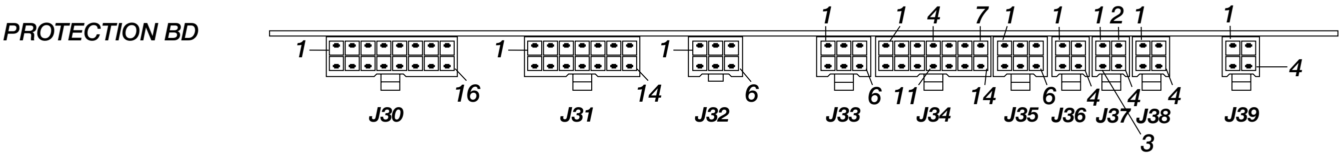
Volt/Ohmmeter (Multimeter)
5/16" Nut driver
3/8" Nut driver
Short piece of jumper wire
Auxiliary Transformer #1 Secondary Circuit Wiring Diagram – Figure F.44.

This procedure takes approximately 25 minutes to perform.

Return to Section TOC
Return to Master TOC

TRIGGER CIRCUIT AND WIRING HARNESS TEST *(continued)*

FIGURE F.43 - PROTECTION BOARD PLUG/HEADER LOCATIONS



TEST PROCEDURE

1. Remove main input supply power to the machine.
2. With the 3/8" nut driver, remove the 4 screws that hold the handle to the machine.
3. Remove the rubber gasket (cover seal) from the lift bail.
4. With the 5/16" nut driver, remove the sheet metal screws from the case top.
5. With the 5/16" nut driver, remove the screws holding the right and left case sides. Remove the case sides by lifting up and out.
6. Perform the ***Capacitor Discharge Procedure*** described earlier in this section of the manual.

WARNING



Before continuing with the test procedure, perform the capacitor discharge procedure to avoid electric shock.

7. After you have completed the capacitor discharge procedure for all four switch boards, remove the PC board cover. Use the 5/16" nut driver.
8. Remove plugs J34, J37, and J38 from the protection board. See ***Figure F.1*** for location. Continue with the following checks:

NOTE: Do not remove plug J33 from the protection board.

A. With the volt/ohmmeter, check for continuity between J37 - pin 1 and J37 - pin 4 of header J37. There should be no continuity.

B. Connect a jumper between J34 - pin 11 and J34 - pin 14 of header J34 of the protection board. This simulates the closing of the trigger on wire feeder 1 or the remote.

C. With the volt/ohmmeter, check for continuity again between J37 - pin 1 and J37 - pin 4 of header J37. There should be continuity now. Remove the jumper.

D. With the volt/ohmmeter, check for continuity between J37 - pin 2 and J37 - pin 3 of header J37. There should be no continuity.

E. Connect a jumper between J34 - pin 4 and J34 - pin 7 of header J34 on the protection board. This simulates the closing of the trigger on wire feeder 2.

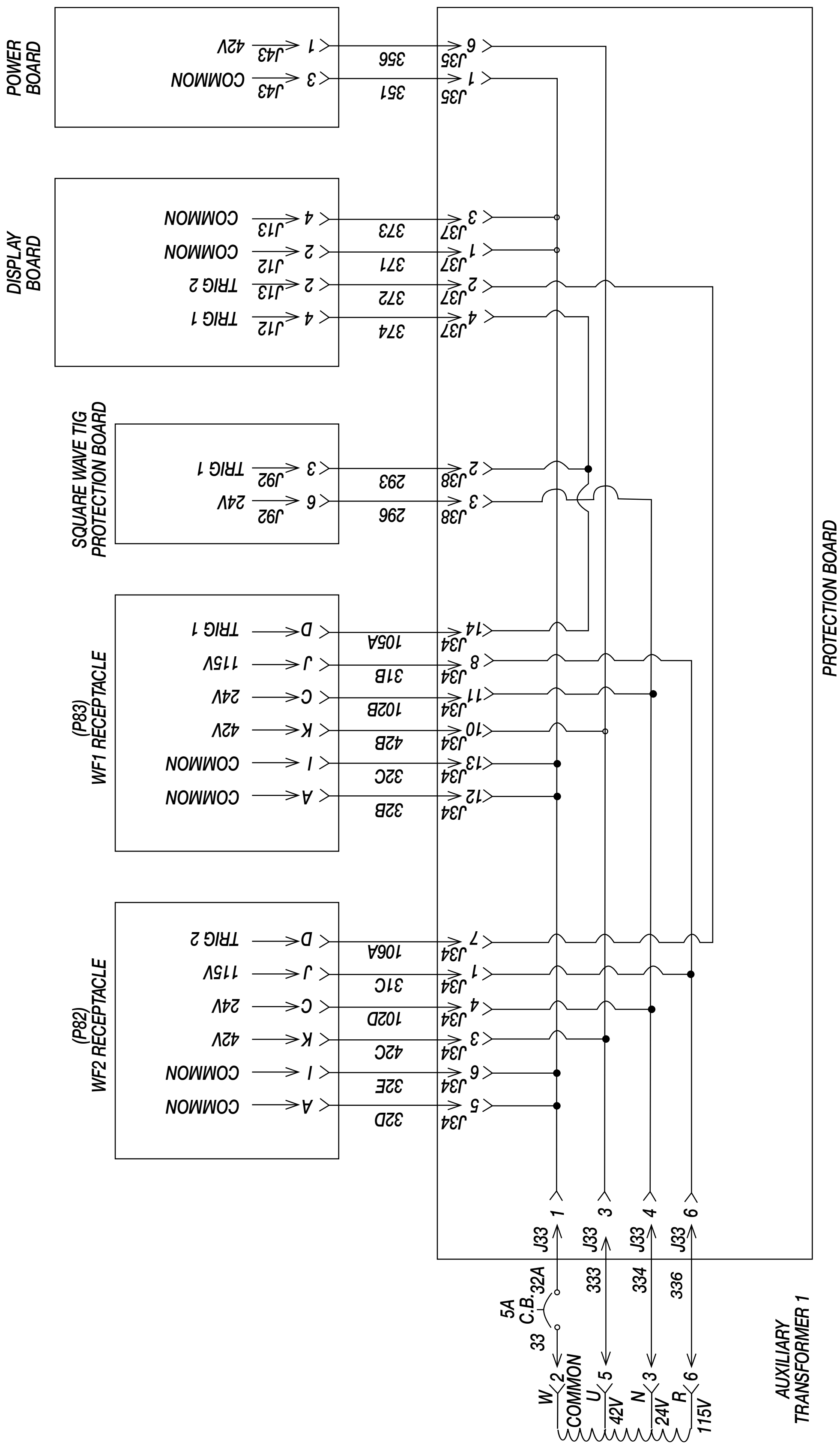
F. With the volt/ohmmeter, check for continuity again between J37 - pin 2 and J37 - pin 3 of header J37. There should be continuity now. Remove the jumper and connect plugs J34, J37, and J38 back into the protection board.

If the continuity tests above detect a fault, replace the protection board.

9. Remove plug J37 from the protection board and inspect its pins and leads. Make sure that the TRIG 1, TRIG 2, and COMMON pins of plug J37 are not shorted together (pins 1, 2, 3, 4, respectively). Make sure that leads #371, #372, #373, and #374 are not exposed. See the Auxiliary Transformer #1 Secondary Circuit Wiring Diagram, ***Figure F.44.***
10. Connect plug J37 to the Protection board. If you found no problem with plug J37 pins and leads, replace the display board.
11. After the tests are completed and the problem successfully repaired, reconnect all plugs to their respective boards. Replace the PC board cover with the two sheet metal screws.
12. Install the machine case sides and top.
13. Install the handle and the lift bail rubber gasket.

Return to Section TOC
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Return to Section TOC
Return to Master TOC

FIGURE F.44
AUXILIARY TRANSFORMER #1 SECONDARY CIRCUIT WIRING DIAGRAM



NOTES

Return to Section TOC
Return to Master TOC
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Return to Section TOC
Return to Master TOC

INTERNAL REMOTE CONTROL TEST

⚠ WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-800-833-9353 (WELD).

TEST DESCRIPTION

This test will determine if there is a fault in the circuitry that reads the control knob commands of the K941-1 Remote Control Kit.

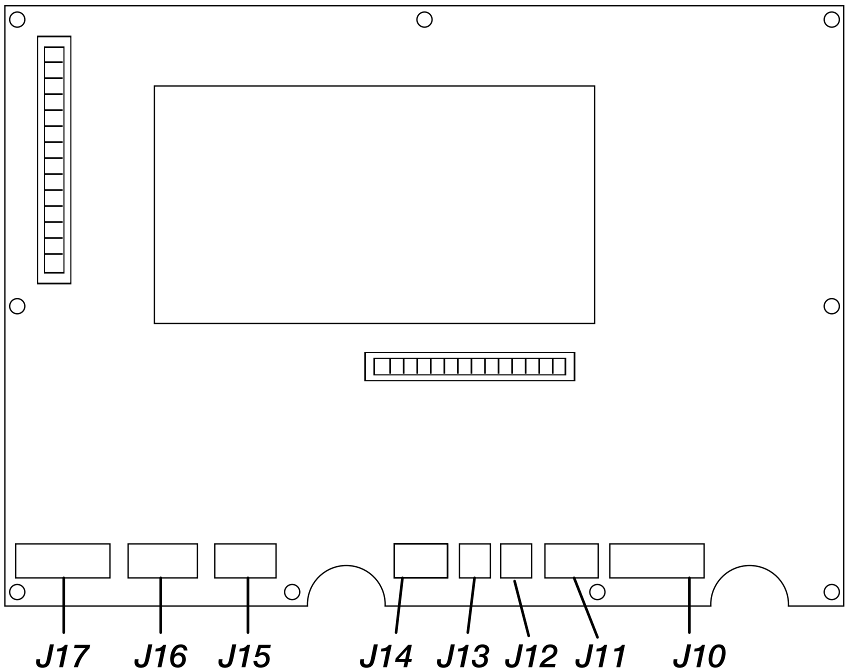
MATERIALS NEEDED

Volt/Ohmmeter (Multimeter)
5/16" Nut driver
3/8" Nut driver
Trigger Circuit Wiring Diagram – Figure F.46

This procedure takes approximately 45 minutes to perform.

INTERNAL REMOTE CONTROL TEST *(continued)*

FIGURE F.45 - DISPLAY BOARD PLUG LOCATIONS



TEST PROCEDURE

1. Remove main input supply power to the machine.
2. With the 3/8" nut driver, remove the 4 screws that hold the handle to the machine.
3. Remove the rubber gasket (cover seal) from the lift bail.
4. With the 5/16" nut driver, remove the sheet metal screws from the case top.
5. With the 5/16" nut driver, remove the screws holding the right and left case sides. Remove the case sides by lifting up and out.
6. Perform the ***Capacitor Discharge Procedure*** described earlier in this section of the manual.

WARNING



Before continuing with the test procedure, perform the capacitor discharge procedure to avoid electric shock.

7. After you have completed the capacitor discharge procedure for all four switch boards, remove the PC board cover. Use the 5/16" nut driver.
8. Remove the 5 leads (3 heavy and 2 small) T1, T2, T3 from main input contactor CR1. This is a safety precaution. It prevents high voltage from being put on the machine during the test. Wrap tape around the lead ends to insulate them and prevent them from touching.
9. Remove plug J30 from the protection board. See ***Figure F.1*** for location of the board and plug J30.

Return to Section TOC
Return to Master TOC

INTERNAL REMOTE CONTROL TEST *(continued)*

WARNING



ELECTRIC SHOCK can kill.

With input power ON, there are high voltages inside the machine, including the protection board. Do not reach into the machine or touch any internal part.

10. Turn input power ON.
11. Turn the knob on the Remote Control Kit all the way counterclockwise.
12. With the volt/ohmmeter, check the voltage between plug J10 - pin 6 (positive) and J10 - pin 7 (negative) on the display board. It should be about zero volts.
13. With the Power Wave set in the SMAW (CC) mode of operation, turn the knob on the Remote Control Kit clockwise. The voltage between plug J10 - pin 6 and J10 - pin 7 should increase smoothly to about 10.25 volts. If this happens but the display shows no change in the preset current value (SET =), replace the display board. If the voltage between pins 6 and 7 does not increase smoothly, test the associated wiring as follows:

A. Turn power switch SW1 to the OFF position and disconnect input power to the machine.

B. Perform the ***Capacitor Discharge Procedure*** described earlier in this section of the manual.

WARNING

Before continuing with the test procedure, perform the capacitor discharge procedure to avoid electric shock.

C. Remove plug J10 from the display board. Check for continuity between the following pins:

J10 - pin 10 and P1 - pin A (of the remote amphenol)

J10 - pin 6 and P1 - pin B (of the remote amphenol)

J10 - pin 7 and P1 - pin C (of the remote amphenol)

14. If you find no continuity between any of these pins, do the following:

A. No continuity between J10 - pin 10 and P1 - pin A (of the remote amphenol):

- Check lead #177A between the remote amphenol and the square wave TIG protection board for continuity.
- Check lead #294 between the square wave TIG protection board and the display board for continuity.
- Check plugs J10, J92, and J93 to make sure the pins are seated properly and not opened up or loose.
- Replace the square wave TIG protection board.

B. No continuity between J10 - pin 6 and P1 - pin B (of the remote amphenol)

- Check lead #176A between the remote amphenol and the square wave TIG protection board for continuity.
- Check lead #291 between the square wave TIG protection board and the display board for continuity.
- Check plugs J10, J92, and J93 to make sure the pins are seated properly and not opened up or loose.
- Replace the square wave TIG protection board.

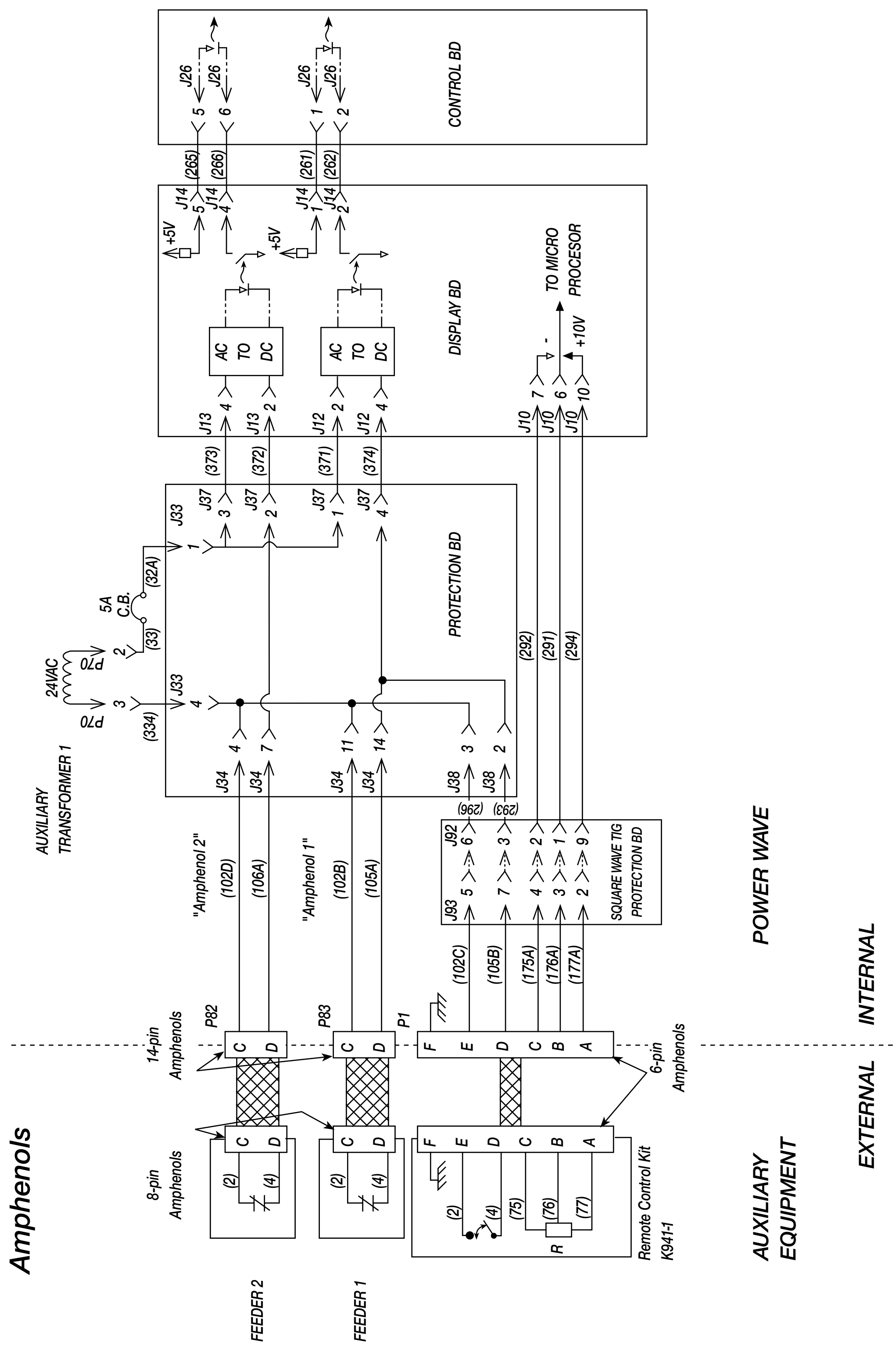
C. No continuity between J10 - pin 7 and P1 - pin C (of the remote amphenol)

- Check lead #175A between the remote amphenol and the square wave TIG protection board for continuity.
- Check lead #292 between the square wave TIG protection board and the display board for continuity.
- Check plugs J10, J92, and J93 to make sure the pins are seated properly and not opened up or loose.
- Replace the square wave TIG protection board.

15. Connect all the plugs disconnected for the tests above.
16. Connect plug J30 into the protection board and replace the PC board cover with two sheet metal screws.
17. Connect the five leads to the main contactor.
18. Install the machine case sides and top.
19. Install the handle and the lift bail rubber gasket.

Return to Section TOC
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Return to Master TOC
Return to Section TOC
Return to Master TOC

FIGURE F.46 – TRIGGER CIRCUIT WIRING DIAGRAM



K941-1 REMOTE CONTROL KIT TEST

⚠ WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-800-833-9353 (WELD).

TEST DESCRIPTION

This test will determine if the K941-1 Remote Control Kit is faulty.

MATERIALS NEEDED

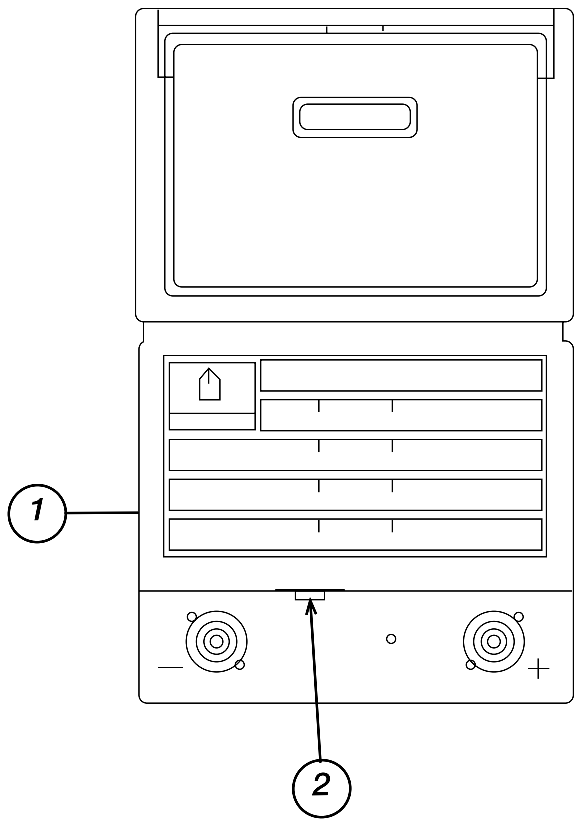
Volt/Ohmmeter (Multimeter)
Trigger Circuit Wiring Diagram – Figure F.48

This procedure takes approximately 20 minutes to perform.

Return to Section TOC
Return to Master TOC

K941-1 REMOTE CONTROL KIT TEST *(continued)*

FIGURE F.47 - 6-PIN AMPHENOL LOCATION



1. MACHINE FRONT PANEL
2. REMOTE CONTROL AMPHENOL RECEPTACLE (6-PIN)

TEST PROCEDURE

1. Remove the Remote Control Kit from the power source.
2. Perform the following tests. If any test fails, the Remote Control Kit is faulty and should be replaced.

A. With the volt/ohmmeter, check the continuity between pin F of the 6-pin amphenol and the case of the Remote Control Kit. The reading should be zero ohms.

B. With the volt/ohmmeter, check the continuity between pin F and the other five pins of the 6-pin amphenol. The reading should be open (no continuity).

C. Set the Output Terminals switch to the ON position. With the volt/ohmmeter, check the continuity between pins D and E of the amphenol. There SHOULD BE continuity (zero ohms).

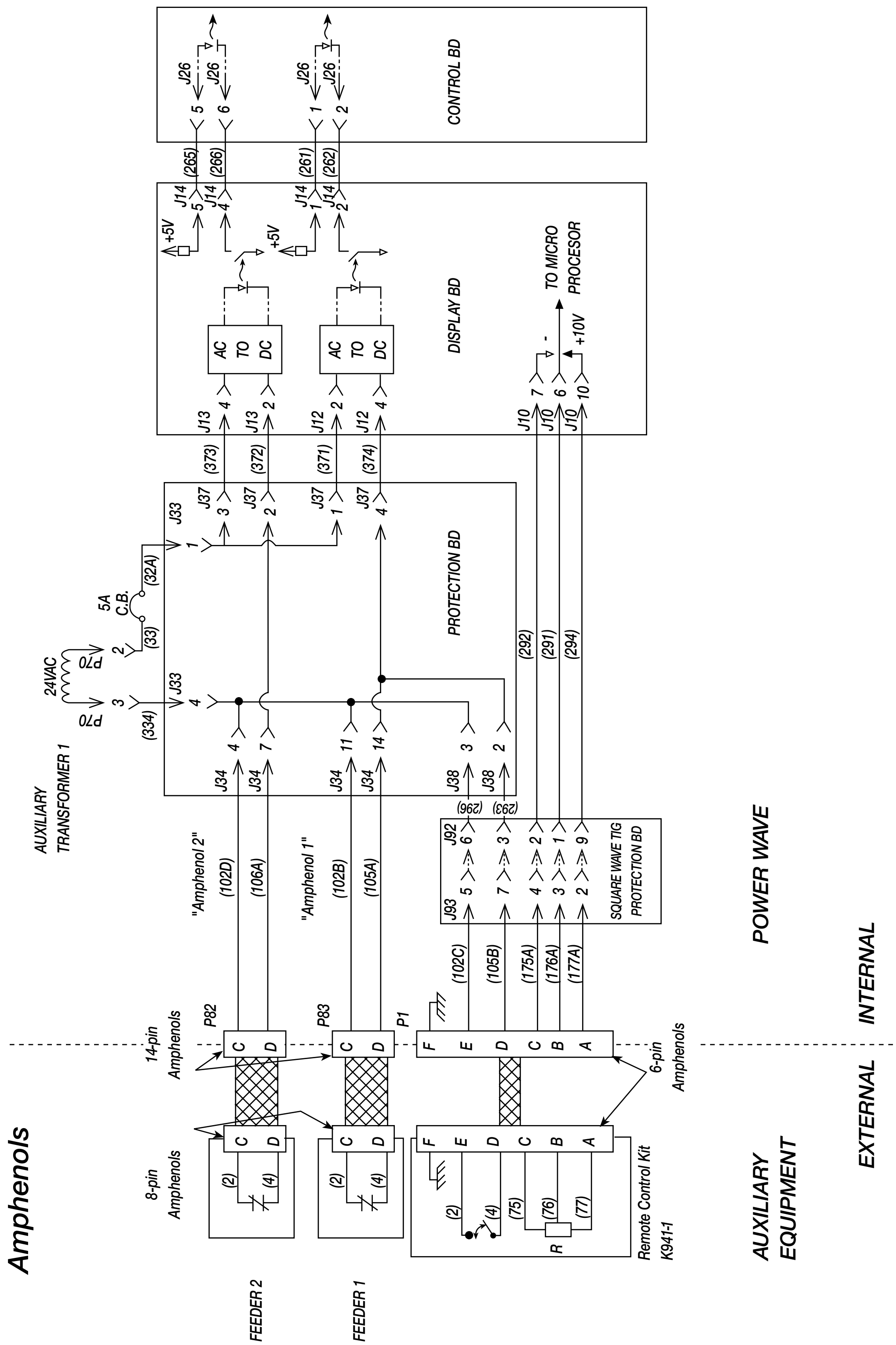
D. Set the Output Terminals switch to the OFF position. With the volt/ohmmeter, check the continuity between pins D and E of the amphenol. There should be NO continuity.

E. With the volt/ohmmeter, check the resistance between pins A and C of the amphenol. There should be 10 Kohm (+/- 10%) resistance between these pins at all times.

F. Turn the knob of the Remote Control Kit all the way counterclockwise. With the volt/ohmmeter, check the resistance between pins A and B of the amphenol. There should be 10 Kohm (+/- 10%) resistance between these pins now. Turn the knob clockwise. The resistance between pins A and B should smoothly decrease to zero ohms (+/- 10%).

Return to Section TOC
Return to Master TOC

FIGURE F.48 – TRIGGER CIRCUIT WIRING DIAGRAM



NOTES

Return to Section TOC
Return to Master TOC
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Return to Section TOC
Return to Master TOC

K941-1 REMOTE CONTROL KIT TRIGGER CIRCUIT TEST

⚠ WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-800-833-9353 (WELD).

TEST DESCRIPTION

This test will determine if there are any faults in the 24 VAC trigger circuit between the Power Wave and the K941-1 Remote Control Kit.

MATERIALS NEEDED

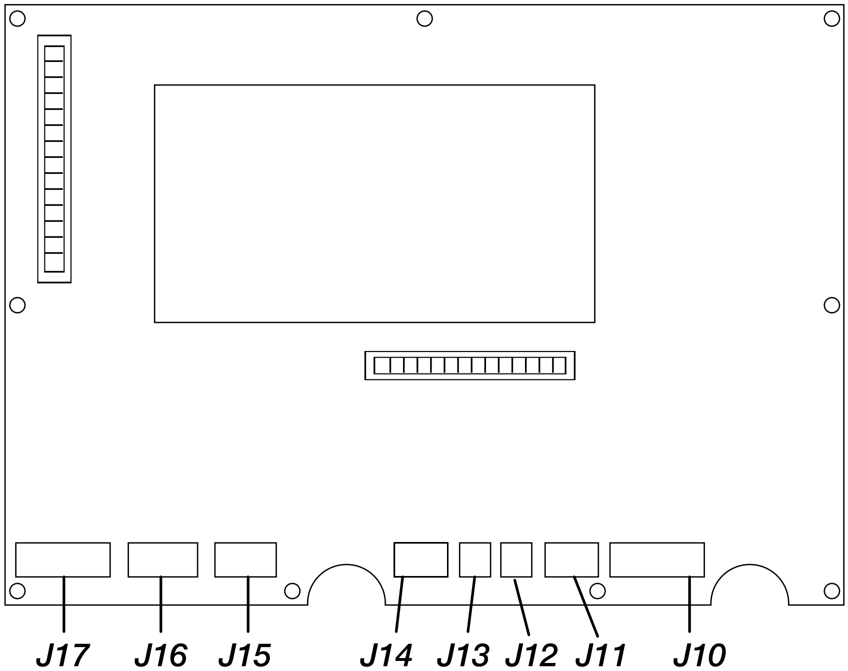
Volt/Ohmmeter (Multimeter)
5/16" Nut driver
3/8" Nut driver
Short piece of jumper wire
Trigger Circuit Wiring Diagram – Figure F.50

This procedure takes approximately 30 minutes to perform.

Return to Section TOC
Return to Master TOC

K941-1 REMOTE CONTROL KIT TRIGGER CIRCUIT TEST *(continued)*

FIGURE F.49 - DISPLAY BOARD PLUG LOCATIONS



TEST PROCEDURE

NOTE: Before troubleshooting the remote control trigger circuit, troubleshoot the remote control kit itself. Refer to the ***K941-1 Remote Control Kit Test*** in this section of the manual. If that test is successful, perform the trigger circuit test below.

1. Remove main input supply power to the machine.
2. With the 3/8" nut driver, remove the 4 screws that hold the handle to the machine.
3. Remove the rubber gasket (cover seal) from the lift bail.
4. With the 5/16" nut driver, remove the sheet metal screws from the case top.
5. With the 5/16" nut driver, remove the screws holding the right and left case sides. Remove the case sides by lifting up and out.
6. Perform the ***Capacitor Discharge Procedure*** described earlier in this section of the manual.

WARNING



Before continuing with the test procedure, perform the capacitor discharge procedure to avoid electric shock.

7. After you have completed the capacitor discharge procedure for all four switch boards, remove the PC board cover. Use the 5/16" nut driver.
8. Remove plug J12 from the display board.
9. Place a jumper wire between pins D and E of the six-pin amphenol.
10. Remove the 5 leads (3 heavy and 2 small) T1, T2, T3 from main input contactor CR1. This is a safety precaution. It prevents high voltage from being put on the machine during the test. Wrap tape around the lead ends to insulate them and prevent them from touching.

K941-1 REMOTE CONTROL KIT TRIGGER CIRCUIT TEST *(continued)*

11. Remove plug J30 from the protection board. See ***Figure F.1*** for location of the board and plug J30.

⚠ WARNING

ELECTRIC SHOCK can kill.

With the input power ON, there are high voltages inside the machine. Do not reach into the machine or touch any internal parts.

12. Turn input power ON.
13. With the volt/ohmmeter, check for 24 VAC between plug J12 - pin 2 and pin 4.

A. If 24 VAC IS present, go to step 14.

NOTE: A voltage of 5 to 10 VDC is normal between these pins without the D to E jumper installed in the six-pin amphenol receptacle.

B. If 24 VAC is NOT present, check for 24 VAC between plug J33 - pin 4 and pin 1. See the Trigger Circuit Wiring Diagram, ***Figure F.50.***

C. If 24 VAC IS present between plug J33 pin 4 and pin 1, check the continuity and integrity of leads #371, 374, 102C, 105B, 296, and 293 and their associated pin connectors. See the Trigger Circuit Wiring Diagram. If the continuity checks are good, check the square wave TIG protection board by checking the continuity through the following pins. See the Trigger Circuit Wiring Diagram, ***Figure F.50.***

Plug J92 - pin 6 to plug J93 - pin 5. Normal resistance is 4 ohms.

Plug J92 - pin 3 to plug J93 - pin 7. Normal resistance is 4 ohms.

If the square wave TIG protection board is good, then the protection board may be faulty. Replace the protection board.

D. If 24 VAC is NOT present between plug J33 pin 4 and pin 1, check Auxiliary Transformer #1, the 5 amp circuit breaker, and the associated wiring. See the Trigger Circuit Wiring Diagram, ***Figure F.50.***

14. Turn input power to the machine OFF and perform the capacitor discharge procedure.
15. Remove plug J26 from the protection board. Attach a 150 ohm resistor between plug J26 - pin 1 and J26 - pin 2 (the J26 plug, not the header on the control board).
16. Replace plug J12 into the display board,

⚠ WARNING

ELECTRIC SHOCK can kill.



With the input power ON, there are high voltages inside the machine, including the protection board. Do not reach into the machine or touch any internal parts.

17. Turn input power ON. The LCD display will read: ERROR: S.L. NOT INITIALIZED. Disregard this; the test can still be performed.
18. Remove the jumper between pins D and E of the six-pin amphenol receptacle.
19. With the volt/ohmmeter, measure the voltage drop across the 150 ohm resistor between J26 - pins 1 and 2. With the jumper removed, the reading should be zero volts (NO voltage drop).
20. Replace the jumper between pins D and E of the six-pin amphenol receptacle. Measure the voltage drop with the jumper installed. The reading should be about 2 VDC across the resistor.

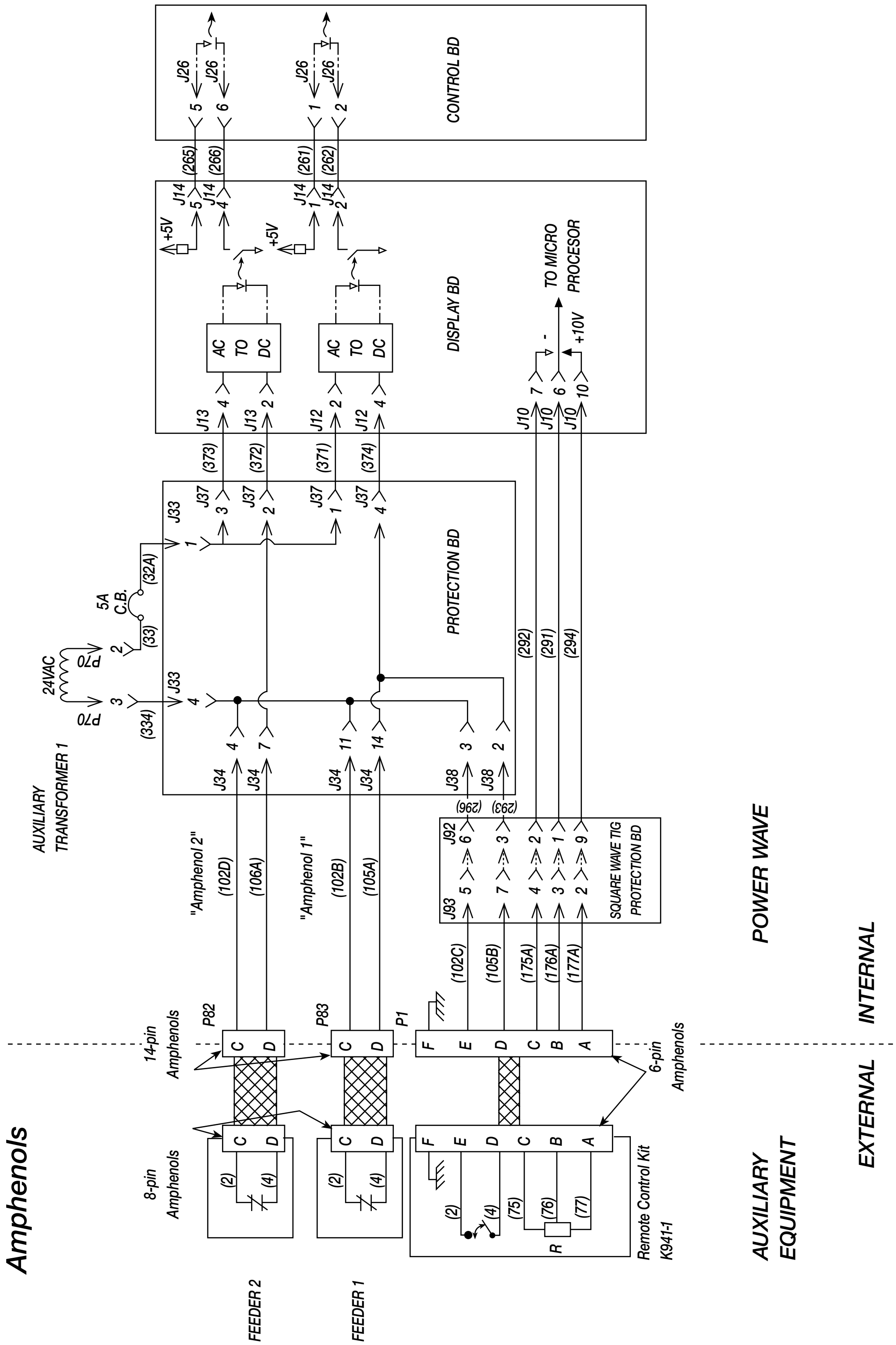
A. If 2 VDC is NOT present, check the continuity and integrity of leads #262 and 261 and their associated pins and connectors. The display board may be faulty -- replace the display board.

B. If 2 VDC IS present across the resistor, the control board may be faulty -- replace the control board.

21. Turn input power to the machine OFF and connect the five leads to the main contactor. Connect all molex plugs to the PC boards and replace the cover with two sheet metal screws. Install the machine case sides, top, handle, and lift bail rubber gasket.

Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC

FIGURE F.50 – TRIGGER CIRCUIT WIRING DIAGRAM



Return to Section TOC
Return to Master TOC

LCD DISPLAY TEST

⚠ WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-800-833-9353 (WELD).

TEST DESCRIPTION

This test will determine if there are any faults in the LCD display on the front panel or in the associated hardware and wiring harness.

MATERIALS NEEDED

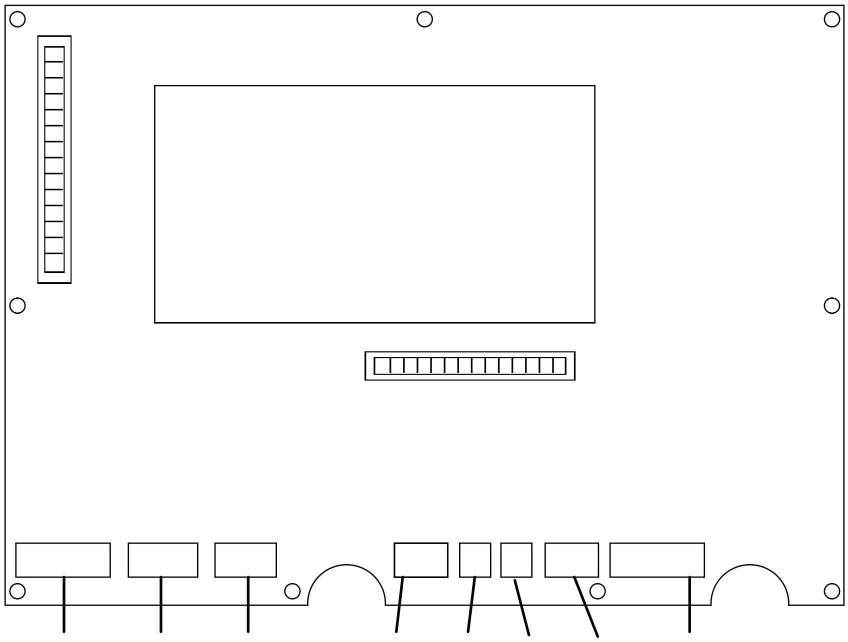
Volt/Ohmmeter (Multimeter)
5/16" Nut driver
3/8" Nut driver
Internal Auxiliary Supply Wiring Diagram – Figure F.52

This procedure takes approximately 30 minutes to perform.

Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC

LCD DISPLAY TEST *(continued)*

FIGURE F.51 - DISPLAY BOARD PLUG LOCATIONS



TEST PROCEDURE

1. Remove main input supply power to the machine.
2. With the 3/8" nut driver, remove the 4 screws that hold the handle to the machine.
3. Remove the rubber gasket (cover seal) from the lift bail.
4. With the 5/16" nut driver, remove the sheet metal screws from the case top.
5. With the 5/16" nut driver, remove the screws holding the right and left case sides. Remove the case sides by lifting up and out.
6. Perform the ***Capacitor Discharge Procedure*** described earlier in this section of the manual.

WARNING



Before continuing with the test procedure, perform the capacitor discharge procedure to avoid electric shock.

7. After you have completed the capacitor discharge procedure for all four switch boards, remove the PC board cover. Use the 5/16" nut driver.
8. Remove the 5 leads (3 heavy and 2 small) T1, T2, T3 from main input contactor CR1. This is a safety precaution. It prevents high voltage from being put on the machine during the test. Wrap tape around the lead ends to insulate them and prevent them from touching.
9. Remove plug J30 from the protection board. See ***Figure F.1*** for location of the board and plug J30.

Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC

LCD DISPLAY TEST *(continued)*

⚠ WARNING



ELECTRIC SHOCK can kill.

With input power ON, there are high voltages inside the machine. Do not reach into the machine or touch any internal part.

10. Turn input power ON.
11. With the volt/ohmmeter, check the following voltages between plug J16 pins at the display board (without removing plug J16 from the display board):

+5 VDC	Between J16 - pin 2 and J16 - pin 3
+15 VDC	Between J16 - pin 10 and J16 - pin 7
+5 VDC	Between J16 - pin 1 and J16 - pin 7
-5 VDC	Between J16 - pin 9 and J16 - pin 7
-8 VDC	Between J16 - pin 6 and J16 - pin 7

12. Turn power switch SW1 to the OFF position and disconnect input power to the machine. Connect plug J30 into the protection board. Connect the five leads to the main contactor.

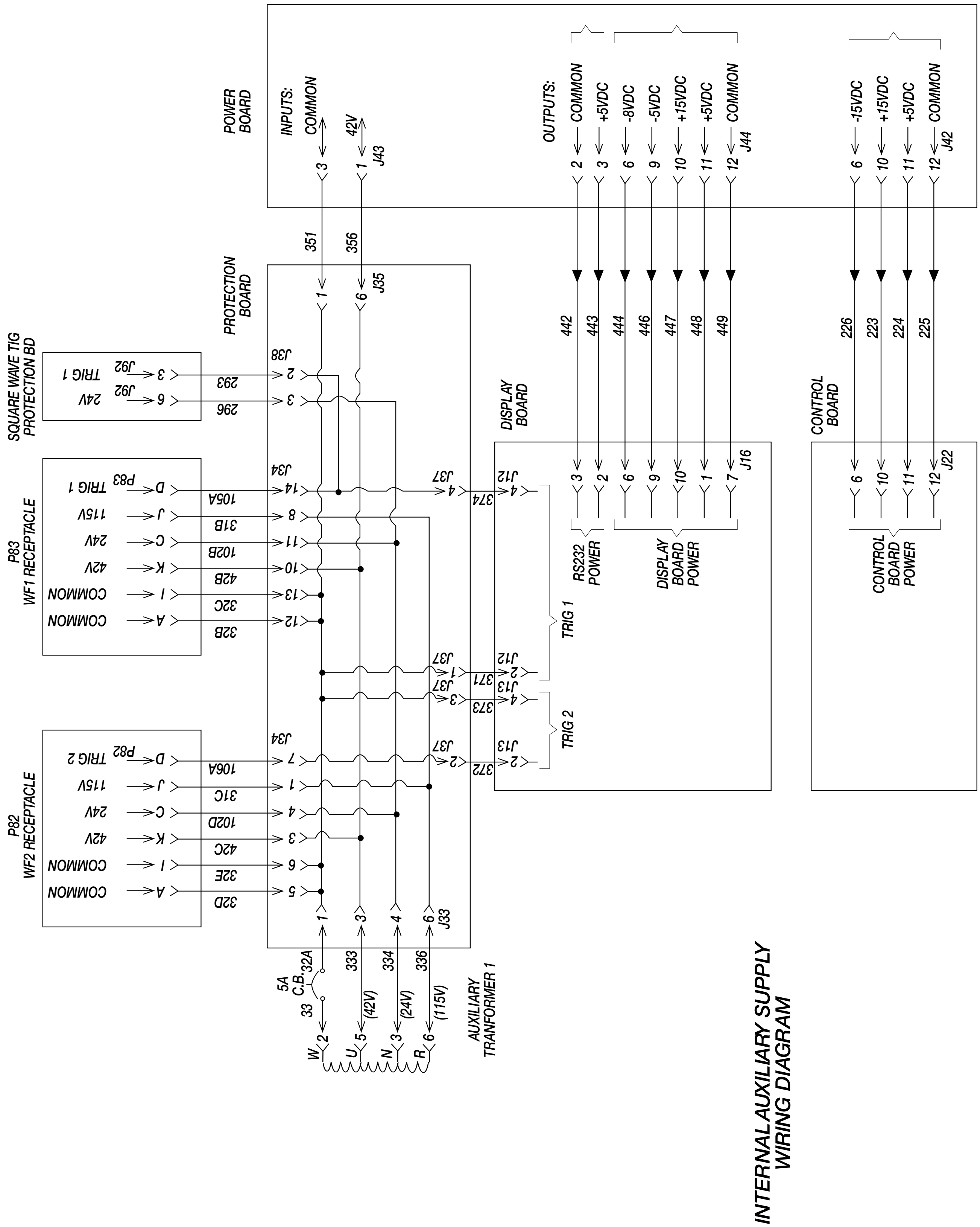
If the voltages checked in step 11 were correct, go to step 14.

If any of the voltages in step 11 were not correct, go to step 13.

13. Perform the following tests to locate the problem: ***Auxiliary Transformer 1 Test*** and ***Internal and Auxiliary Voltage Supply Test.*** If these tests show no component failures, go to step 14.
14. Make sure plug J19 is plugged into the display board securely and that none of its pins are loose or broken. If the pins are all okay, replace the LCD display.
15. If the problem persists after replacing the LCD display, replace the display board.
16. After the problem has be repaired, install the machine case sides and top. Install the handle and the lift bail rubber gasket.

Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC

FIGURE F.52 – INTERNAL AUXILIARY SUPPLY WIRING DIAGRAM



Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC

CALIBRATION PROCEDURES

POWER WAVE PC BOARD REPLACEMENT CALIBRATION PROCEDURES

If the display board is replaced, the display sensor calibration and a voltage calibration must be performed for optimum performance. If the calibration is not done the voltage may be accurate only to within 3 volts. If the sensor calibration is not done, the display board may have some problems sensing the correct overlay on power up.

⚠ WARNING

The display is shipped with the water cooler disabled. If an internal water cooler is being used with the Power Wave, you must use the Setup Overlay L9770-0 to enable the water cooler before using the system.

If the control board is replaced, the voltage calibration and current calibration must be performed for optimum performance. If the calibration is not done, the voltage may be accurate only to within 3 volts and the current will be accurate only to within 15 amps.

NOTES

Return to Section TOC
Return to Master TOC

SENSOR CALIBRATION TEST (FOR DISPLAY BOARD)

⚠ WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-800-833-9353 (WELD).

TEST DESCRIPTION

This procedure recalibrates the eight overlay sensors of the Power Wave.

MATERIALS NEEDED

Power Wave Test and Calibration Overlay – L9660-255
Set-Up Overlay – L9660

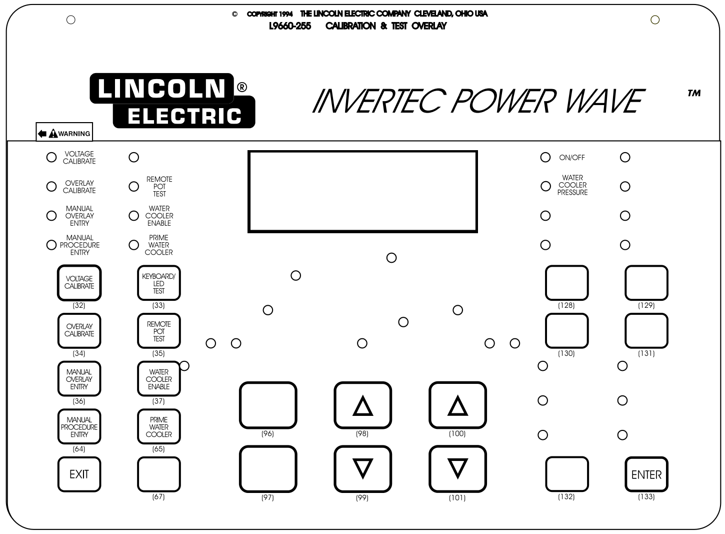
This procedure takes approximately 15 minutes to perform.

Return to Section TOC
Return to Master TOC

SENSOR CALIBRATION TEST (FOR DISPLAY BOARD) *(continued)*

FIGURE F.53 - SENSOR LOCATION BEHIND OVERLAY

1. LEADS 300, 301 TO PLUG J15 ON DISPLAY BOARD
2. PIEZO-ELECTRIC ALARM BUZZER



PROCEDURE

1. Turn the machine ON with no overlay in place. The overlay ID number displayed should be 255.

2. When the display reads SELECT A FUNCTION, place the TEST overlay on the machine.

3. Press key #34 - OVERLAY CALIBRATE. The OVERLAY CALIBRATE light turns on and for a few seconds the display reads:

   OVERLAY SENSOR
   CALIBRATION

Then the display changes to read:

   INSERT REF OVRLY
   PRESS ENTER . . .

Insert set-up overlay

4. Press key #133 - ENTER. The machine will begin to calibrate the eight overlay sensors.

5. If one of the sensors could not be calibrated, the display reads:

   SENSOR X FAILED
   ENTER TO RETRY

Make sure the overlay is lined up properly and press key #133 - ENTER. This will cause the machine to try to calibrate the sensor again. If a particular sensor continues to fail. Clean sensor or replace display board.

6. If the calibration procedure is successful, the display reads:

   CALIBRATION
   SUCCESSFUL

After a few seconds the display changes to read:

   INSERT CAL OVRLY
   PRESS ENTER . . .

7. Press key #133 - ENTER. the OVERLAY CALIBRATE LED turns off, the machine exits the OVERLAY CALIBRATE function and the display reads:

SELECT A FUNCTION

8. Turn the power switch SW1 to the OFF position. To use the machine, place the appropriate overlay in position and turn power switch SW1 to the ON position.

NOTE: Turn power switch SW1 to the OFF position and get the overlay that was not recognized by the power wave. Replace the TEST overlay with this overlay and turn the machine ON. The machine should recognize the overlay now. If it does not, the overlay is faulty.

Return to Section TOC
Return to Master TOC

QUICK VOLTAGE CALIBRATION

WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-800-833-9353 (WELD).

PROCEDURE DESCRIPTION

This procedure is a quick way of calibrating the voltage sensing points (leads), provided that the existing display board is capable of displaying the calibration numbers that are stored in the display board.

MATERIALS NEEDED

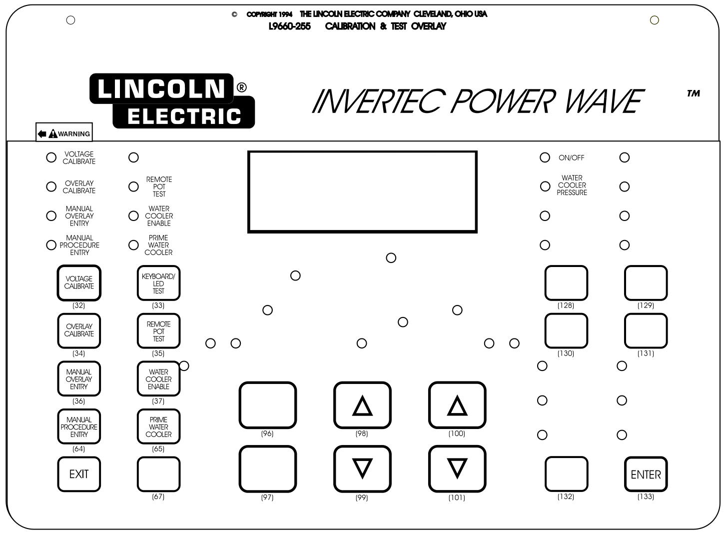
A known "good" replacement display board
A Test and Calibration overlay L9660-255

This procedure takes approximately 15 minutes to perform.

Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC

QUICK VOLTAGE CALIBRATION *(continued)*

FIGURE F.54 - TEST AND CALIBRATION OVERLAY



PROCEDURE

1. Before changing or disturbing the display board, power up the machine with the L9660-255 Test and Calibration overlay in place. See Figure F.54.
2. Press the Voltage Calibration function (32). The machine should display the following:

   VOLTAGE WIRE
   + POLARITY (+67A)

3. Press the Enter Key (133) on the lower right side of the overlay. The machine should display the following:

   ADJUST TO 30V
   CALIBRATION #=XX

NOTE: Here "XX" indicates a particular calibration number for a given voltage sensing point.

⚠ WARNING

The machine's output terminals will be electrically "HOT" when the Enter Key is pressed.

4. Record the number displayed for the +67 wire and press the Enter Key (133) again.
5. Repeat the process by pressing the Voltage Calibration function again. The next sensing lead may be selected by pressing the down Arrow Key (101). The above procedure must be repeated six times to obtain and record the calibration number for six different voltage sensing points. These points are the following:

   + Polarity (+67A)
   + Polarity (+67B)
   - Polarity (+21A)
   - Polarity (+21B)
   + Polarity
   - Polarity

6. Install the "new" replacement display board.
7. With the L9660-255 overlay installed, apply power to the machine. Press the Voltage Calibration function (32). Enter the recorded calibration numbers for each of the six voltage sensing points. The calibration numbers are entered by selecting the proper sensing point (lead), pressing the Enter Key (133) and obtaining the display that reads:

   ADJUST TO 30V
   CALIBRATION #=XX

   The calibration number is changed using the up/down Arrow Keys (100, 101). Press the Enter Key when the desired number is displayed.

8. Repeat the process for all six sensing points (leads).
9. Perform the ***Sensor Calibration Test.***

FULL VOLTAGE CALIBRATION

WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-800-833-9353 (WELD).

PROCEDURE DESCRIPTION

This procedure is necessary if the display board is replaced and the Quick Voltage Calibration is NOT possible. The Full Voltage Calibration is also necessary if the snubber and/or control boards are replaced.

MATERIALS NEEDED

A Test and Calibration Overlay L9660-255
A 300 amp, 30 volt resistive grid load. (A MIG welding load may be used if a grid load is not available. Choose an argon rich 30 volt spray procedure.) See the topic Full Voltage Calibration Using a Welding Arc in this section of the manual.
A calibrated DC voltmeter accurate to 30.0 volts +/- 0.1 volt.
A set of jumper leads to access the remote voltage sensing leads in the wire feeder amphenol receptacles.

SETUP PROCEDURE

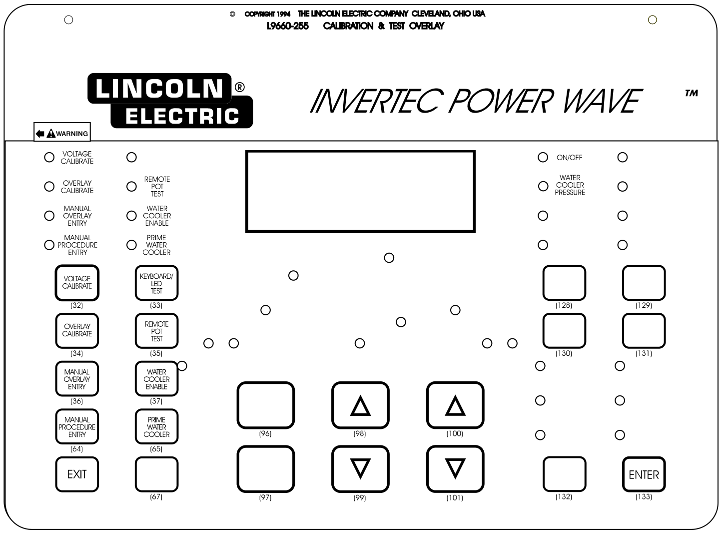
1. Using the jumper leads, connect 21A (H) and 67A (N), located in wire feeder receptacle #1, to the machine's positive output terminal.
2. Using the jumper leads, connect 21B (H) and 67B (N), located in wire feeder receptacle #2, to the machine's positive output terminal.
3. Connect the resistive grid load (or wire feeder) to the machine's output terminals.
4. Connect the DC voltmeter to the machine's output terminals. Do not connect the voltmeter to the load. This avoids erroneous readings due to cable drop.

This procedure takes approximately 45 minutes to perform.

Return to Section TOC
Return to Master TOC

FULL VOLTAGE CALIBRATION *(continued)*

FIGURE F.55 - TEST AND CALIBRATION OVERLAY



PROCEDURE

1. The voltage calibration numbers are stored in the display board. They are programmable from the front panel using the Test and Calibration Overlay.
2. Change the PC board in question.
3. Install the Test and Calibration Overlay L9660-255 and power up the machine. See Figure F.55.
4. Press the Voltage Calibration function (32). The machine should display the following:

VOLTAGE WIRE
+ POLARITY (+67A)

5. Press the Enter Key (133) on the lower right side of the overlay. The machine should display the following:

ADJUST TO 30V
CALIBRATION #=XX

NOTE: Here "XX" indicates a particular calibration number for a given voltage sensing point.

⚠ WARNING

The machine's output terminals will be electrically "HOT" when the Enter Key is pressed.

6. With the machine loaded, monitor the reference voltage only (external voltmeter). It is the only important reading. Adjust the voltage using the Arrow Keys (100 and 101) until the reference voltmeter reads 30.0 volts. Press the Enter Key.

6a. If using a synergic 7 wire feeder, press enter then adjust to the desired w.f.s Note the gun will be electrically "hot" at this time.

⚠ CAUTION

WHEN LOADING THE MACHINE WITH THE CASE PARTS REMOVED, BE CAREFUL NOT TO OVERHEAT THE MACHINE.

7. Repeat the process by pressing the Voltage Calibration function again. The next voltage sensing point (lead) may be selected by pressing the down Arrow Key (101). The above procedure must be repeated six times to set the six sensing points (leads) to 30.0 volts. The six test points (leads) are the following:

+ Polarity (+67A)
+ Polarity (+67B)
- Polarity (+21A)
- Polarity (+21B)
+ Polarity
- Polarity

8. If the display board is replaced or disturbed, perform the ***Sensor Calibration Test.***

FULL VOLTAGE CALIBRATION USING A WELDING ARC

WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-800-833-9353 (WELD).

PROCEDURE DESCRIPTION

This procedure is necessary if the display board is replaced and the Quick Voltage Calibration or the Normal Full Voltage Calibration is NOT possible.

MATERIALS NEEDED

A Test and Calibration overlay L9660-255 (the test procedure can be done within this)
A Synergic 7 wire feeder.
A calibrated DC voltmeter accurate to 0.1 volts at 30.0 volts.
The proper welding wire and gas combination to produce a Spray Arc. For example, 0.035 L-50 wire with a 90% Argon and 10% CO_2 blend of gas.

SETUP PROCEDURE

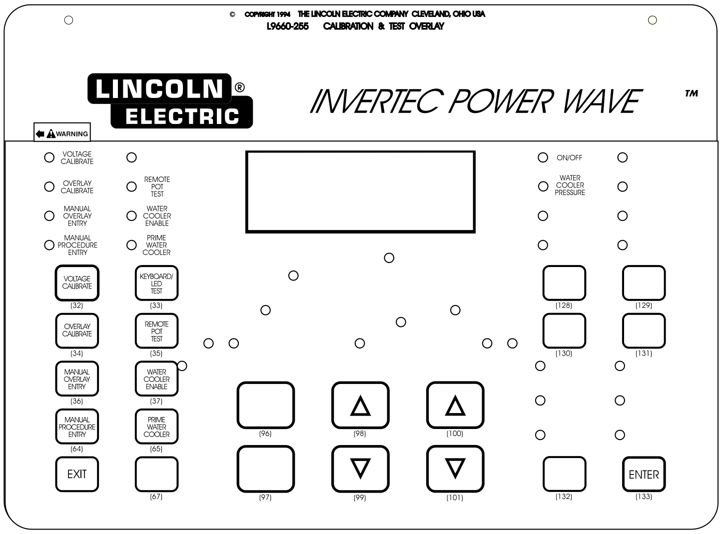
1. Connect a DC voltmeter to the machine's negative output terminal and the conductor block of the wire feeder.
2. Connect the Synergic 7 wire feeder to the Wire Feeder 1 amphenol on the back of the Power Wave.

This procedure takes approximately 45 minutes to perform.

Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC

FULL VOLTAGE CALIBRATION *(continued)*

FIGURE F.55a - TEST AND CALIBRATION OVERLAY



PROCEDURE

1. The voltage calibration numbers are stored in the display board. They are programmable from the front panel using the Test and Calibration Overlay.

2. Change the display board in question.

3. Install the Test and Calibration overlay L9660-255 (or do not insert any overlay into the machine) and power up the machine. See Figure F.55a. If the -255 overlay is not available, use Figure F.55a as a guide to see which keys to press.

4. Press the Voltage Calibration function (32). The machine should display the following:

   VOLTAGE WIRE
   + POLARITY (+67A)

5. Press the Enter Key (133) on the lower right side of the overlay. The machine should display the following:

   ADJUST TO 30V
   CALIBRATION# = XX

NOTE: Here "xx" indicates a particular calibration number for a given voltage sense point.

⚠ WARNING

The machine's output terminals will be electrically "HOT" when the Enter Key is pressed.

6. Adjust the wire feed speed on the Synergic 7 to 500 IPM (some wire feed speed to get into the spray range).

NOTE: When the Enter Key is pressed it will clear the wire feed speed to 200 IPM. The wire feed speed must be adjusted after pressing the Enter Key but before starting to weld.

7. Pull the trigger on the torch and start to weld. Hold a long stick out. This is not normally a welding technique. The starting will be poor. The welding may be poor. Maintain a long, steady welding arc. While welding, monitor the reference voltage only (external voltmeter). It is the only important reading. Adjust the voltage using the Arrow Keys (100 and 101) until the reference voltmeter reads 30.0 volts. Record the number on the display, "xx". Press the Enter Key. Release the trigger on the torch.

8. Repeat the process by pressing the Voltage Calibration function (32) again. The next voltage sensing point may be selected by pressing the down Arrow Key (101). Repeat steps 5, 6, and 7 for the following test points.

Return to Section TOC
Return to Master TOC

FULL VOLTAGE CALIBRATION*(continued)*

– POLARITY (+21A)
+ POLARITY
– POLARITY

NOTE: Do not attempt to weld for –Polarity (+21A). Set the number to the same as recorded for +Polarity (+67A). Also for +Polarity and –Polarity, move the voltmeter sense lead from the conductor block of the wire feeder to the positive output terminal on the front of the machine.

9. Turn the machine off. Connect the Synergic 7 to the Wire feeder 2 amphenol on the back of the Power Wave machine.

10. Put the voltmeter sense lead back on the wire feeder conductor block and repeat the calibration process steps 5, 6, and 7 for the following test points:

+POLARITY (+67B)
–POLARITY (+21B)

NOTE: Do not attempt to weld for –Polarity (+21B). Set the number to the same as recorded for +Polarity (+67B).

NOTES

Return to Section TOC Return to Master TOC

CURRENT CALIBRATION

WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-800-833-9353 (WELD).

PROCEDURE DESCRIPTION

This procedure is necessary if the control and/or the shunt amplifier boards are replaced. The current control is the most critical function in the Power Wave machine.

MATERIALS NEEDED

Test and Calibration Overlay L9660-255
A 300 amp, 30 volt resistance grid load
A small trimmer screwdriver
A calibrated DC ammeter accurate to read 300.0 amps +/- 1.0 amps.
A machine output triggering device such as the K941-1 Remote Control Kit.

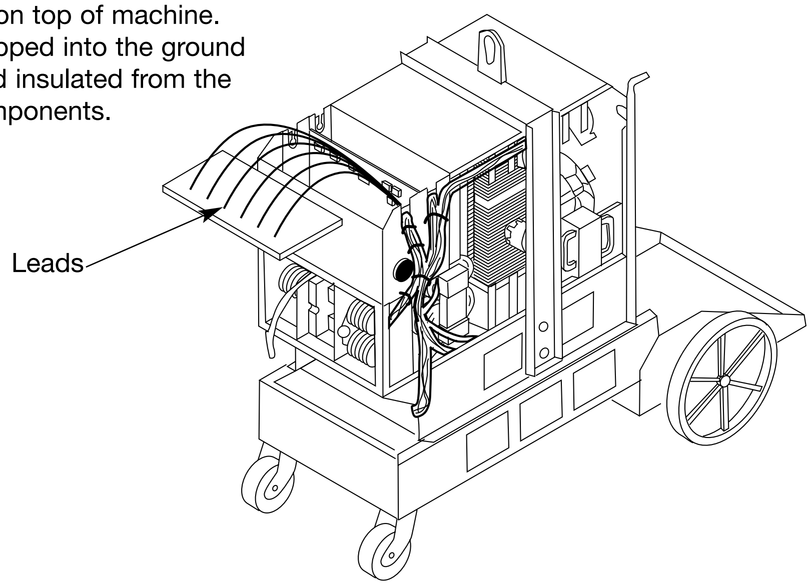
SETUP PROCEDURE

1. Remove and install the replacement board in question.

This procedure takes approximately 45 minutes to perform.

FIGURE F.56 – PC BOARD REMOVED BUT STILL CONNECTED

Lay Control Board on top of machine. Make sure it is snapped into the ground plane assembly and insulated from the case and other components.



CURRENT CALIBRATION *(continued)*

2. Locate the 10 turn trimmer potentiometer located on the control board. It is the only trimmer on the board. If the trimmer is not accessible with the control board installed, then the board must be removed and laid on the top of the PC board compartment. Be sure the control board is insulated from the other boards and the case parts. All wiring plugs must be connected to the control board. See ***Figure F.56.***

WARNING

WHEN THE MACHINE CASE IS REMOVED HIGH VOLTAGE POINTS ARE EXPOSED.

STAND DIRECTLY IN FRONT OF MACHINE UNDER TEST.

EXPLODING PARTS CAN CAUSE INJURY. FAILED PARTS CAN EXPLODE OR CAUSE OTHER PARTS TO EXPLODE WHEN POWER IS APPLIED. ALWAYS WEAR A FACE SHIELD AND LONG SLEEVES WHEN SERVICING.

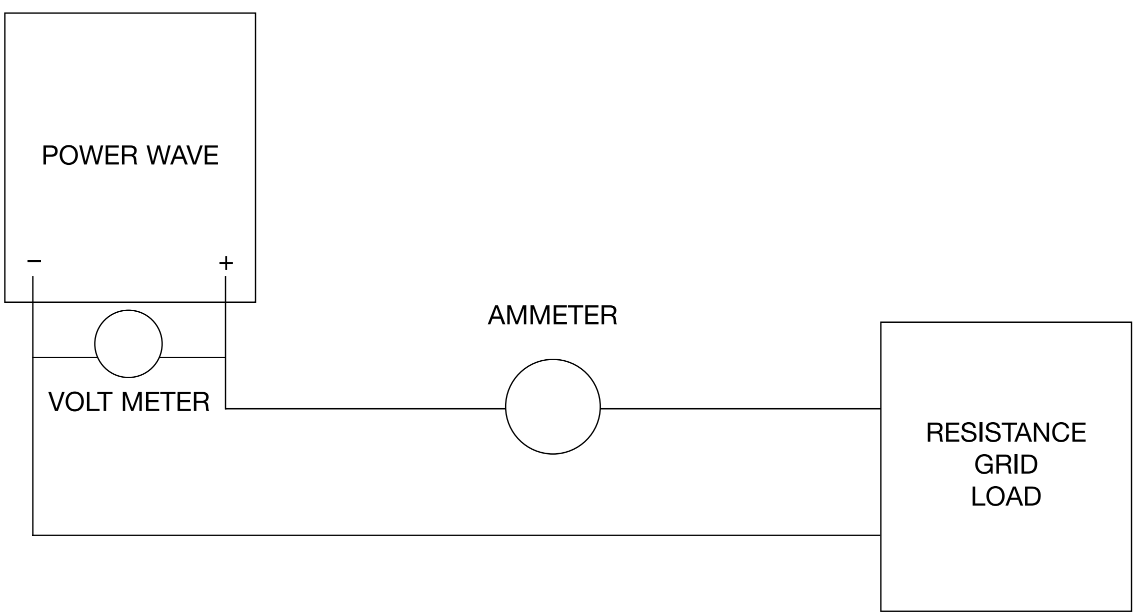
CAUTION

WHEN LOADING THE MACHINE WITH THE CASE PARTS REMOVED. BE CAREFUL NOT TO OVER HEAT THE MACHINE.

3. **NOTE:** If a wire feeder is NOT connected to the Power Wave the machine may not display output volts.

4. Connect the resistance grid load to the machine's output terminals. Connect the reference ammeter in series with the grid load. See Figure F.57.

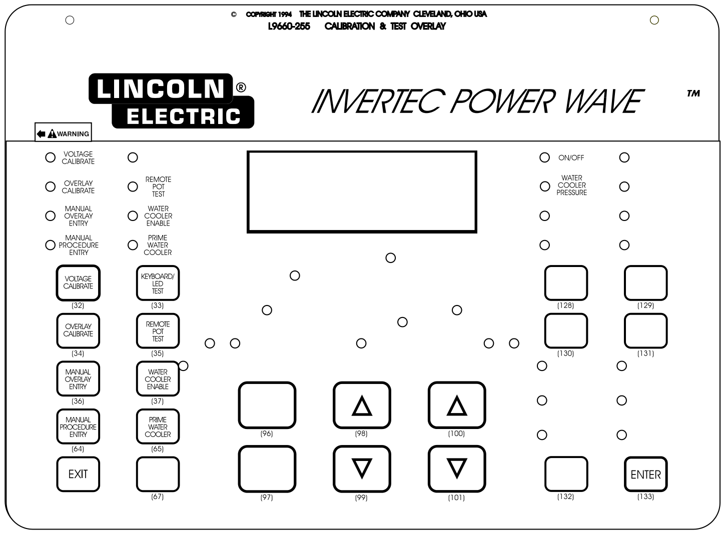
FIGURE F.57 – RESISTANCE GRID LOAD CONNECTIONS



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Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC

CURRENT CALIBRATION *(continued)*

FIGURE F.58 – TEST AND CALIBRATION OVERLAY



PROCEDURE

1. Install the Test and Calibration Overlay and apply power to the machine. See Figure F.58.
2. Press the Manual Procedure Entry Key (64). The machine should display the following:

   PROCESS 1 SETUP
   1-0

3. Toggle the Arrow Keys (100 and 101) until the display reads:

   PROCESS 1 SETUP
   1-6

4. Activate the external trigger device. (K941-1) and load the machine.

⚠ WARNING

The machine's output terminals will be electrically "HOT" when the trigger circuit is activated.

5. Adjust the potentiometer until the reference (external ammeter) reads 304 amps +/- 1.0 amps. The load voltage should be greater than 15 volts but less than 35 volts.
6. Remove power to the machine.
7. If necessary re-install the control board.
8. Replace the machine case parts.

NOTES

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T1 AUXILIARY TRANSFORMER REMOVAL AND REPLACEMENT

⚠ WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-800-833-9353 (WELD).

DESCRIPTION

The following procedure will aid the technician in removing the T1 auxiliary transformer for maintenance or replacement.

MATERIALS NEEDED

5/16" Nut driver
3/8" Nut driver or socket wrench
Wire cutters
Machine Wiring Diagram in the Electrical Diagrams section of this manual

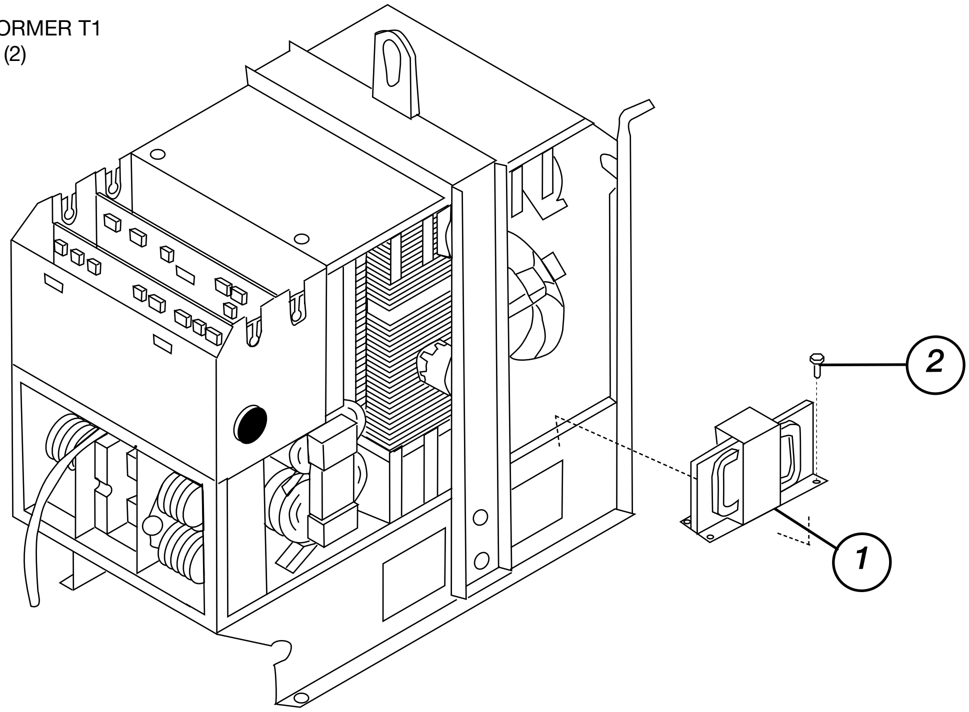
This procedure takes approximately 35 minutes to perform.

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Return to Master TOC
Return to Section TOC
Return to Master TOC

T1 AUXILIARY TRANSFORMER REMOVAL AND REPLACEMENT *(continued)*

FIGURE F.59 - T1 AUXILIARY TRANSFORMER LOCATION

1. AUXILIARY TRANSFORMER T1
2. MOUNTING SCREW (2)



PROCEDURE

1. Remove main input supply power to the machine.
2. With the 3/8" nut driver, remove the 4 screws that hold the handle to the machine.
3. Remove the rubber gasket (cover seal) from the lift bail.
4. With the 5/16" nut driver, remove the sheet metal screws from the case top.
5. With the 5/16" nut driver, remove the screws holding the right and left case sides. Remove the case sides by lifting up and out.
6. Perform the ***Capacitor Discharge Procedure*** described earlier in this section of the manual.

⚠ WARNING



Before continuing with the test procedure, perform the capacitor discharge procedure to avoid electric shock.

7. After you have completed the capacitor discharge procedure for all four switch boards, disconnect plugs P70, P71, and P73 that attach to the transformer. See Figure F.59 for location.
8. With the wire cutters, cut any necessary cable ties (necessary for removal of the transformer). Note the location of these cable ties for reassembly.
9. With the 3/8" nut driver or socket wrench, remove the two screws that mount the transformer to the machine base. Remove the T1 auxiliary transformer.
10. To install the T1 auxiliary transformer, carefully position it onto the machine base and tighten the two mounting screws. Connect plugs P70, P71, and P73 to their respective receptacles on the transformer.
11. Install the machine case sides and top.
12. Install the handle and the lift bail rubber gasket.

WATER COOLER REMOVAL AND REPLACEMENT

For later model coolers (Inlet & Outlet on lower left of machine back)
Refer to IM645-A

⚠ WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-800-833-9353 (WELD).

DESCRIPTION

The following procedure will aid the technician in removing the machine water cooler assembly for maintenance or replacement.

MATERIALS NEEDED

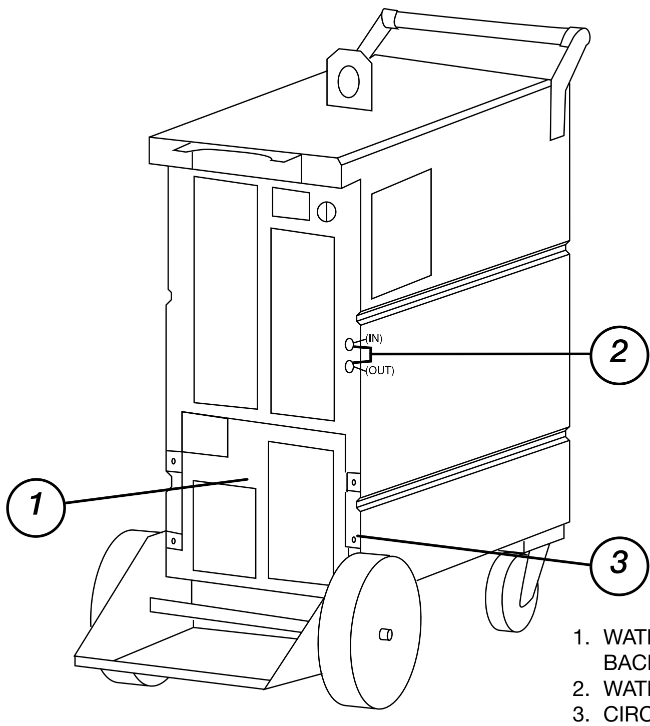
5/16" Nut driver
9/16" Open end or box wrench
3/8" Nut driver or socket wrench
3/4" Open end wrench
11/16" Open end wrench
Machine Wiring Diagram in the Electrical Diagrams section of this manual

This procedure takes approximately 60 minutes to perform.

Return to Section TOC
Return to Master TOC

WATER COOLER REMOVAL AND REPLACEMENT *(continued)*

FIGURE F.60 - WATER COOLER LOCATION



1. WATER COOLER ACCESS DOOR (ON BACK PANEL)
2. WATER COOLING FITTINGS
3. CIRCUIT BREAKER

PROCEDURE

NOTE: These instructions may vary slightly with later model coolers. See instructions included with cooler kit.

1. Remove main input supply power to the machine.
2. With the 3/8" nut driver, remove the 4 screws that hold the handle to the machine.
3. Remove the rubber gasket (cover seal) from the lift bail.
4. With the 5/16" nut driver, remove the sheet metal screws from the case top.
5. With the 5/16" nut driver, remove the screws holding the right and left case sides. Remove the case sides by lifting up and out.
6. Perform the ***Capacitor Discharge Procedure*** described earlier in this section of the manual.

WARNING

Before continuing with the test procedure, perform the capacitor discharge procedure to avoid electric shock.

7. After you have completed the capacitor discharge procedure for all four switch boards, use the 5/16" nut driver to remove the water cooler access door. See Figure F.60 for location.
8. With the 3/8" open end or socket wrench, remove the two water cooler assembly mounting screws. Slide the assembly to the left to better access the circuit breaker, which will be removed in a moment.
9. With the 5/16" nut driver, remove the two sheet metal screws holding the lower case back panel.

WATER COOLER REMOVAL AND REPLACEMENT *(continued)*

10. With the 9/16" open end wrench, remove the circuit breaker.
11. Locate and disconnect plug J4, behind the water cooler. Plug J 4, a large molex plug, has two leads (H1A and H3A). Double-check that these are the leads feeding the plug; there is another large molex plug in the same area that is not connected to the water cooler.
12. Disconnect Plug 3, a small molex plug with four leads. This plug is also located behind the water cooler.
13. Slide out the water cooler assembly. Take care not to damage the reservoir tank and cooling coils.
14. If complete removal is required, with the 3/4" and 11/16" open end wrenches, disconnect the water cooler lines from the machine back panel. Disconnect the plastic strain relievers that hold the water lines to the subframe.

If disassembly of the water cooler is required, refer to the ***Water Cooler Disassembly Procedure*** in this section of the manual.

15. To install the water cooler, slide the assembly into the machine base. Make sure the cooler fits under the retaining clips. Connect the water lines to the back panel and connect the plastic strain relievers where they hold the water lines to the subframe.
16. Connect plugs 3 and 4, behind the water cooler assembly.
17. Attach the circuit breaker. Use the 9/16" open end wrench.
18. Install the two 5/16" sheet metal screws that hold the lower case back panel.
19. Install the two 3/8" water cooler assembly mounting screws.
20. Connect the water cooler lines to the back panel using the 3/4" and 11/16" wrenches.
21. Set the tabs of the water cooler access door in place and secure the door with the two 5/16" screws.
22. Install the machine case sides and top.
23. Install the handle and the lift bail rubber gasket.

NOTES

Return to Section TOC
Return to Master TOC
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Return to Master TOC
Return to Section TOC
Return to Master TOC

WATER COOLER DISASSEMBLY

⚠ WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-800-833-9353 (WELD).

DESCRIPTION

The following procedure will aid the technician in disassembly of the machine water cooler assembly for maintenance or part replacement for early model coolers.

MATERIALS NEEDED

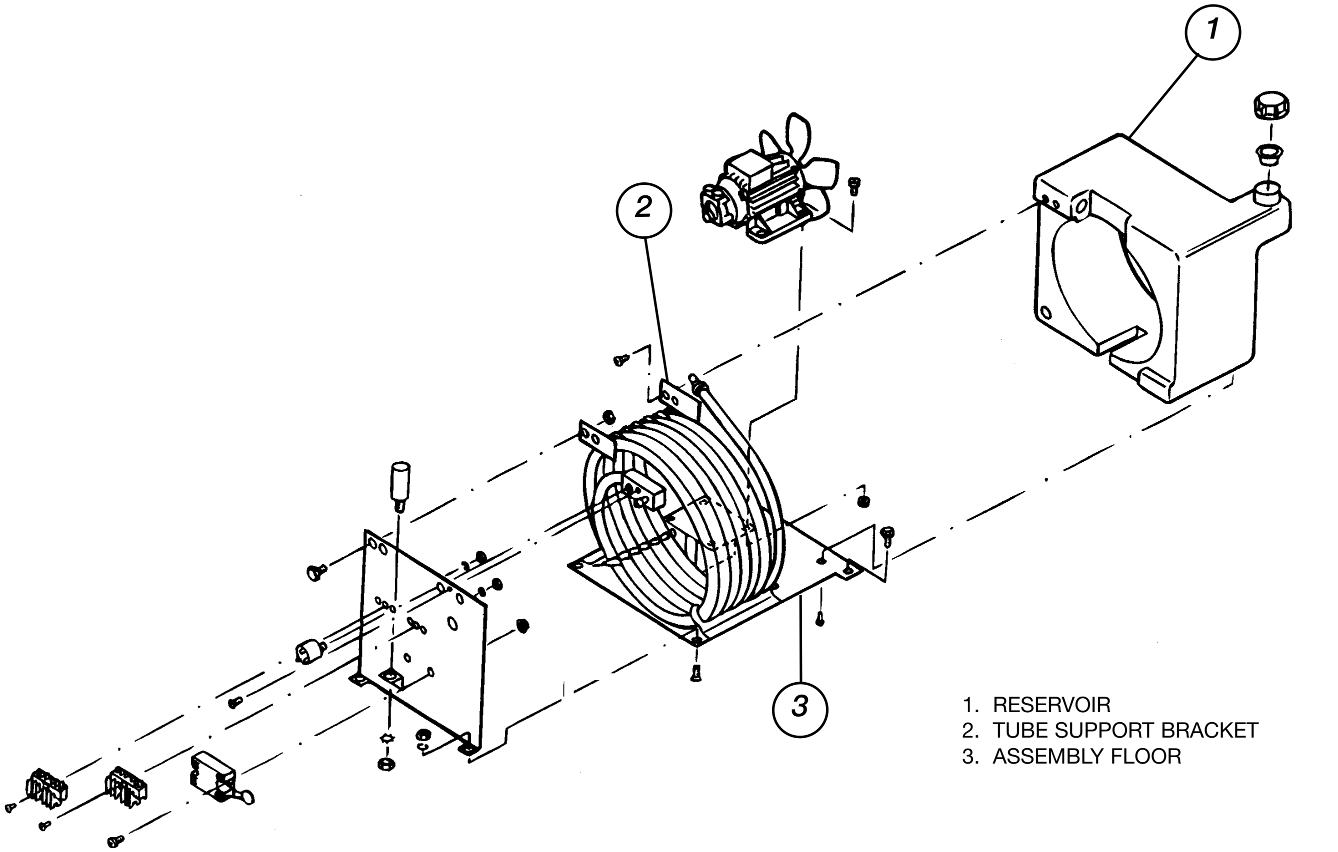
Phillips head screw driver
Pliers
3/4" Open end wrench
5/16" Box wrench

This procedure takes approximately 60 minutes to perform.

Return to Section TOC
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Return to Master TOC
Return to Section TOC
Return to Master TOC

WATER COOLER DISASSEMBLY *(continued)*

FIGURE F.61 - WATER COOLER DISASSEMBLY (EARLY MODEL)



PROCEDURE

1. Remove main input supply power to the machine.
2. With the 3/8" nut driver, remove the 4 screws that hold the handle to the machine.
3. Remove the rubber gasket (cover seal) from the lift bail.
4. With the 5/16" nut driver, remove the sheet metal screws from the case top.
5. With the 5/16" nut driver, remove the screws holding the right and left case sides. Remove the case sides by lifting up and out.
6. Perform the ***Capacitor Discharge Procedure*** described earlier in this section of the manual.

WARNING



Before continuing with the test procedure, perform the capacitor discharge procedure to avoid electric shock.

Return to Section TOC
Return to Master TOC

WATER COOLER DISASSEMBLY *(continued)*

Reservoir Removal

A. After you have completed the capacitor discharge procedure for all four switch boards, remove the water cooler assembly. Refer to the ***Water Cooler Removal and Replacement Procedure*** in this section of the manual.

B. Empty the coolant from the reservoir. Dispose of the coolant in a proper and approved manner.

C. With the Phillips head screw driver, remove the two screws holding the reservoir to the cooling tube support bracket.

D. With the Phillips head screw driver, remove the four screws holding the reservoir to the floor of the assembly.

E. With the pliers, carefully remove the two coolant hoses from the reservoir.

F. Carefully slide out and lift the reservoir free from the motor and fan blade.

G. After repair, install the reservoir by carefully setting it in place around the motor and fan blade. With the pliers, install the two coolant hoses to the reservoir. With the Phillips head screw driver, install the four screws holding the reservoir to the floor of the assembly and the two screws that hold it to the cooling tube support bracket. Replace the old coolant with fresh coolant and install the water cooler assembly into the machine according to the ***Water Cooler Removal and Replacement Procedure*** in this section of the manual.

Motor/Pump/Fan Assembly Removal

A. Perform the Reservoir Removal procedure.

B. With the 3/4" open end wrench, remove the two coolant hoses attached to the motor/pump assembly.

C. Remove the four wires leading from the motor to the terminal block. Note the lead numbers and locations for reassembly.

D. With the Phillips head screw driver and the 5/16" box wrench, remove the four screws and nuts mounting the motor/pump/fan assembly to the mounting platform.

E. Carefully lift out the motor/pump/fan assembly.

F. Install the motor/pump/fan assembly by carefully setting in onto the mounting platform and attaching it with the four screws and nuts. Connect the four wire leads from the motor to the terminal block. Attach the two coolant hoses to the motor/pump assembly using the 3/4" open end wrench.

7. Install the reservoir according to the directions in the Reservoir Removal procedure. Install the water cooler assembly according to the Water Cooler Removal and Replacement procedure in this section of the manual.

8. Install the machine case sides and top.

9. Install the handle and the lift bail rubber gasket.

NOTES

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Return to Section TOC
Return to Master TOC

T2 AUXILIARY TRANSFORMER REMOVAL AND REPLACEMENT

⚠ WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-800-833-9353 (WELD).

DESCRIPTION

The following procedure will aid the technician in removing the T2 auxiliary transformer for maintenance or replacement.

MATERIALS NEEDED

5/16" Nut driver
3/8" Nut driver or socket wrench
Machine Wiring Diagram in the Electrical Diagrams section of this manual

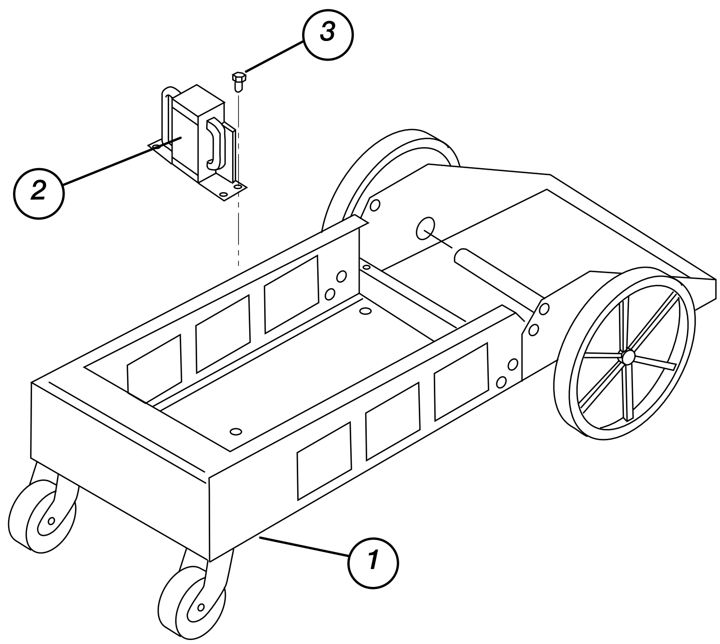
This procedure takes approximately 30 minutes to perform.

Return to Section TOC
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Return to Section TOC
Return to Master TOC

T2 AUXILIARY TRANSFORMER REMOVAL AND REPLACEMENT *(continued)*

FIGURE F.62 - T2 AUXILIARY TRANSFORMER LOCATION

1. BASE
2. AUXILIARY TRANSFORMER T2
3. MOUNTING SCREW (2)



PROCEDURE

1. Remove main input supply power to the machine.
2. With the 3/8" nut driver, remove the 4 screws that hold the handle to the machine.
3. Remove the rubber gasket (cover seal) from the lift bail.
4. With the 5/16" nut driver, remove the sheet metal screws from the case top.
5. With the 5/16" nut driver, remove the screws holding the right and left case sides. Remove the case sides by lifting up and out.
6. Perform the ***Capacitor Discharge Procedure*** described earlier in this section of the manual.

⚠ WARNING

Before continuing with the test procedure, perform the capacitor discharge procedure to avoid electric shock.

7. After you have completed the capacitor discharge procedure for all four switch boards, proceed to remove the T2 auxiliary transformer. First you will have to remove the water cooler; follow the ***Water Cooler Removal and Replacement Procedure*** in this section of the manual.
8. Disconnect the single molex plug attached to the transformer. See Figure F.62 for location.
9. The 3/8" nut driver or socket wrench, remove the two screws that mount the transformer to the machine base. Remove the T2 auxiliary transformer.
10. To install the T2 auxiliary transformer, carefully position it onto the machine base and tighten the two mounting screws. Connect the molex plug to its receptacle on the transformer.
11. Install the water cooler. Refer to the ***Water Cooler Removal and Replacement Procedure*** in this section of the manual.
12. Install the machine case sides and top.
13. Install the handle and the lift bail rubber gasket.

FAN MOTOR REMOVAL AND REPLACEMENT

⚠ WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-800-833-9353 (WELD).

DESCRIPTION

The following procedure will aid the technician in removing the machine fan motor for maintenance or replacement.

MATERIALS NEEDED

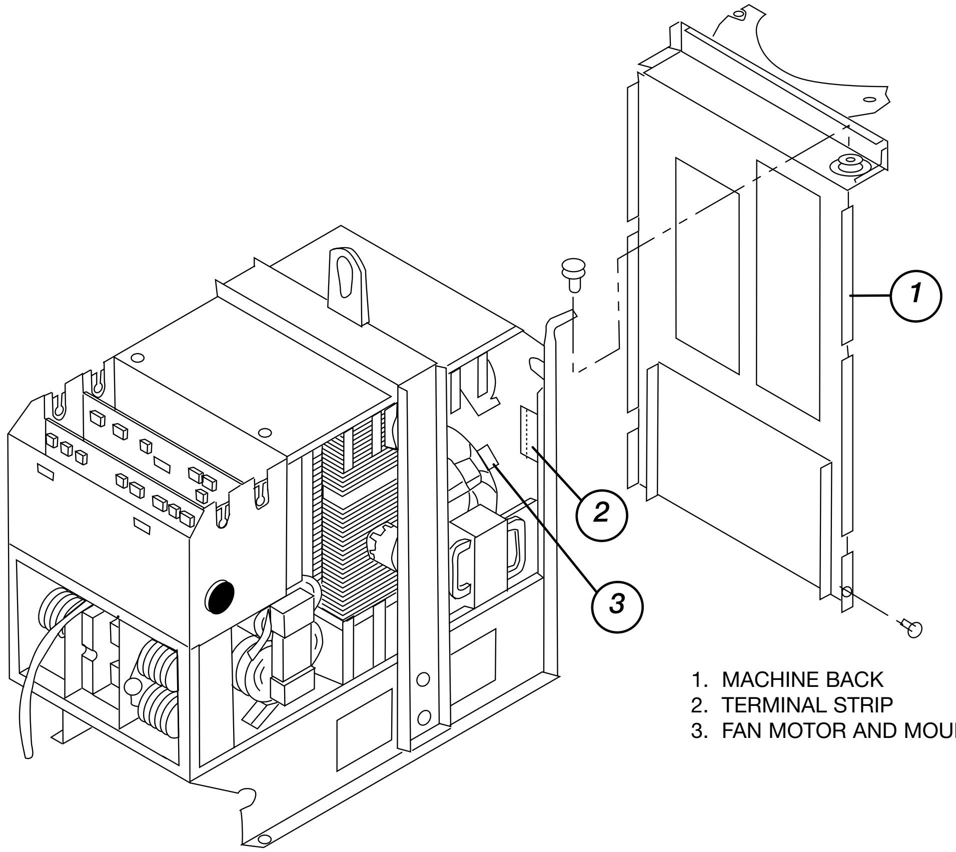
5/16" Nut driver
3/8" Nut driver
3/4" Open or box end wrench
Wire cutters
Slot head screw driver
Machine Wiring Diagram in the Electrical Diagrams section of this manual

This procedure takes approximately 30 minutes to perform.

Return to Section TOC
Return to Master TOC

FAN MOTOR REMOVAL AND REPLACEMENT *(continued)*

FIGURE F.63 - FAN MOTOR LOCATION



1. MACHINE BACK
2. TERMINAL STRIP
3. FAN MOTOR AND MOUNTING BRACKET

PROCEDURE

1. Remove main input supply power to the machine.
2. With the 3/8" nut driver, remove the 4 screws that hold the handle to the machine.
3. Remove the rubber gasket (cover seal) from the lift bail.
4. With the 5/16" nut driver, remove the sheet metal screws from the case top.
5. With the 5/16" nut driver, remove the screws holding the right and left case sides. Remove the case sides by lifting up and out.
6. Perform the ***Capacitor Discharge Procedure*** described earlier in this section of the manual.

⚠ WARNING



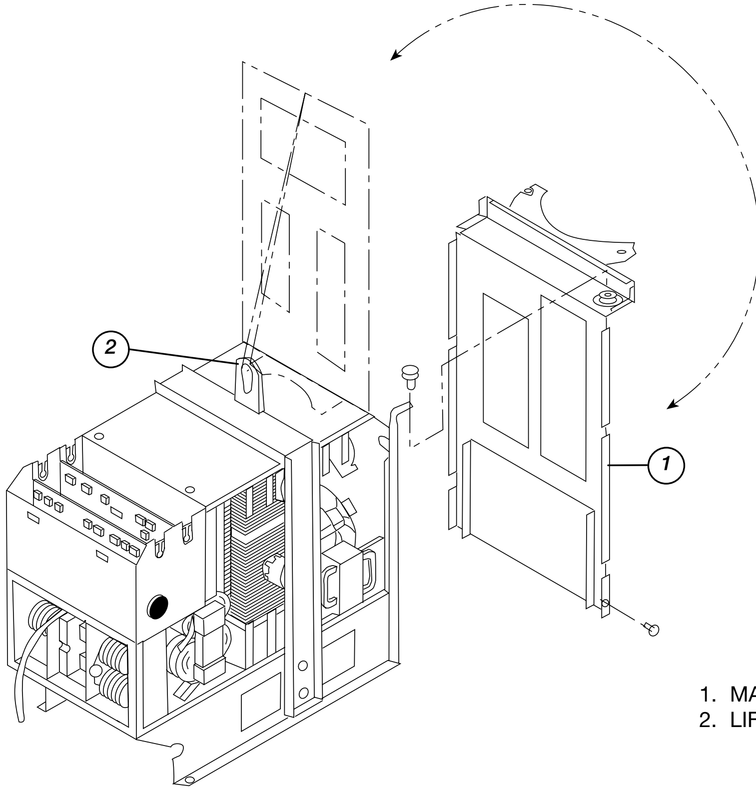
Before continuing with the test procedure, perform the capacitor discharge procedure to avoid electric shock.

7. After you have completed the capacitor discharge procedure for all four switch boards, use the wire cutters to cut any necessary cable ties (necessary for removal of the fan motor) holding the fan motor leads together. Note the location of these cable ties for reassembly.
8. Remove the fan motor leads from the terminal strip.
9. With the 5/16" nut driver, remove the water cooler access door. Then remove the four screws from the lower rear panel.

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Return to Master TOC

FAN MOTOR REMOVAL AND REPLACEMENT *(continued)*

FIGURE F.64 - MACHINE BACK SECURED TO LIFT BAIL.



11. With the 3/4" wrench, remove the lead connected to the rear positive (+) output terminal.
12. Swing the back panel up and secure it to the lift bail. See Figure F.64. Use heavy string or wire. BE CAREFUL NOT TO DAMAGE THE RS232 CONNECTOR OR THE WIREFEEDER RECEPTACLES.
13. With the slot head screw driver, remove the clip holding the fan blade onto the motor shaft.
14. Remove the fan blade by carefully sliding it off the motor shaft.
15. With the 11/32" nut driver or socket wrench, remove the two fan motor mounting nuts. Remove the split-ring lock washers and flat washers.
16. Remove the fan motor by sliding it out of the mounting bracket and free of the machine.

NOTE: Repeat this procedure to remove the second fan motor if necessary.

17. To install the fan motor, do the following: Carefully position the fan motor into place on the mounting bracket with the leads toward the terminal strip. Install the flat washers, split-ring lock washers, and nuts to the motor mounting bolts. Carefully slide the fan blade all the way onto the motor shaft. The side of the hub with the metal clip goes toward the motor. Install the clip so that it grips the rounded side of the D-shaped shaft, not the flat. Swing the back panel back down, being careful not to damage the RS232 connector or the wire feeder receptacles. Install the lead to the rear positive (+) output terminal. Install the case back lower sides and the lower rear panel with the 5/16" screws. Attach the fan motor leads to the terminal strip and replace the tie wraps cut during removal so that the motor leads are held away from the fan blades.
18. Install the machine case sides and top.
19. Install the handle and the lift bail rubber gasket.

NOTES

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Return to Section TOC
Return to Master TOC

INPUT RECTIFIER REMOVAL AND REPLACEMENT

⚠ WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-800-833-9353 (WELD).

DESCRIPTION

The following procedure will aid the technician in removing the input rectifier for maintenance or replacement.

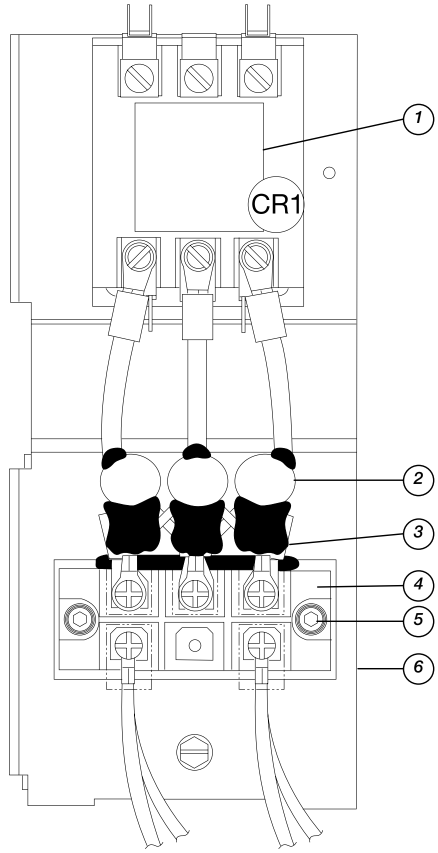
MATERIALS NEEDED

5 mm Allen wrench
Phillips head screw driver
10 mm Open end wrench
RTV Silicone sealant (Lincoln E2861)
Dow Corning 340 Joint Compound (Lincoln E1868)
S18491 M.O.V. Assembly (if necessary)
Machine Wiring Diagram in the Electrical Diagrams section of this manual

This procedure takes approximately 45 minutes to perform.

INPUT RECTIFIER REMOVAL AND REPLACEMENT *(continued)*

FIGURE F.65 - INPUT RECTIFIER LOCATION



1. MAIN CONTACTOR
2. M.O.V. ASSEMBLY
3. SILICONE SEALANT
4. INPUT RECTIFIER
5. 5MM ALLEN SCREW
6. HEAT SINK PANEL

PROCEDURE

1. Remove main input supply power to the machine.
2. With the 3/8" nut driver, remove the 4 screws that hold the handle to the machine.
3. Remove the rubber gasket (cover seal) from the lift bail.
4. With the 5/16" nut driver, remove the sheet metal screws from the case top.
5. With the 5/16" nut driver, remove the screws holding the right and left case sides. Remove the case sides by lifting up and out.
6. Perform the ***Capacitor Discharge Procedure*** described earlier in this section of the manual.

WARNING



Before continuing with the test procedure, perform the capacitor discharge procedure to avoid electric shock.

7. After you have completed the capacitor discharge procedure for all four switch boards, peel the silicone sealant away from the M.O.V. assembly in order to expose the heads of the screws that attach the three heavy leads from the main input contactor to the input rectifier. See Figure F.65.
8. With the Phillips head screw driver, remove the three heavy leads from the input rectifier.
9. With the Phillips head screw driver, remove the positive (+) and negative (-) leads from the input rectifier.

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Return to Master TOC
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Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC

INPUT RECTIFIER REMOVAL AND REPLACEMENT *(continued)*

10. With the 5 mm Allen wrench and the 10 mm open end wrench, remove the two screws mounting the input rectifier to the heat sink panel.
11. When replacing the input rectifier, apply a thin, even coating of Dow Corning 340 Joint Compound (Lincoln T12837) to the mating surfaces between the input rectifier and the heat sink panel. Avoid applying the compound to either the mounting holes or the mounting hardware.
12. Mount the input rectifier to the heat sink panel and tighten the two mounting screws with the 5 mm Allen wrench and the 10 mm open end wrench. Be sure to tighten the screws evenly.
13. With the Phillips head screw driver, attach the positive (+) and negative (-) leads to the input rectifier. Attach the three heavy leads and the M.O.V. assembly to the input rectifier. Replace the M.O.V. assembly if it appears damaged.
14. Apply silicone sealant to the M.O.V. assembly connections.
15. Install the machine case sides and top.
16. Install the handle and the lift bail rubber gasket.

NOTES

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Return to Master TOC
Return to Section TOC
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Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC

PRINTED CIRCUIT BOARD REMOVAL AND REPLACEMENT (CONTROL BOARD, POWER BOARD, AND PROTECTION BOARD)

⚠ WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-800-833-9353 (WELD).

DESCRIPTION

The following procedure will aid the technician in removing the control, power, or protection printed circuit boards for maintenance or replacement.

MATERIALS NEEDED

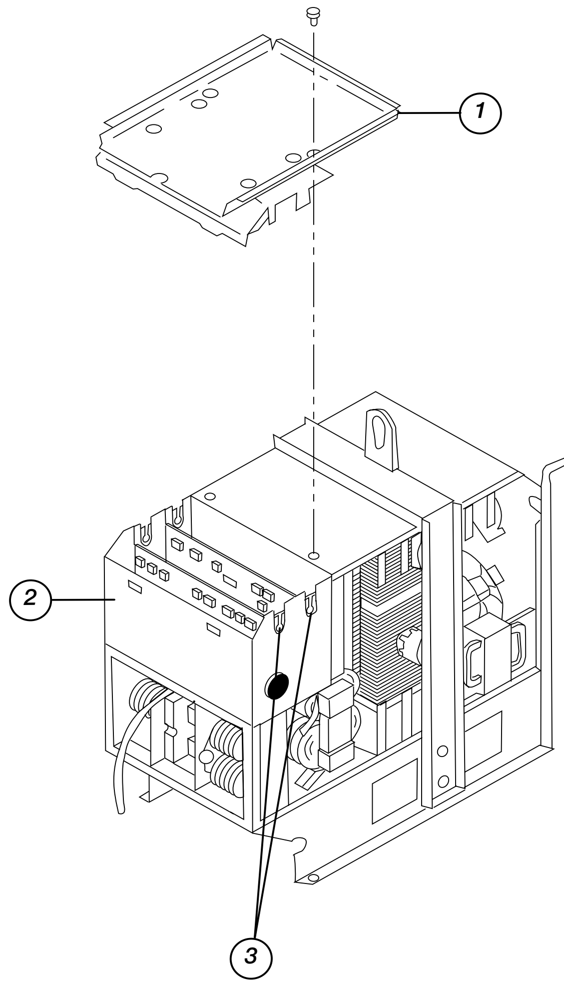
5/16" Nut driver
3/8" Nut driver
Machine Wiring Diagram in the Electrical Diagrams section of this manual

This procedure takes approximately 30 minutes to perform.

Return to Section TOC
Return to Master TOC

PRINTED CIRCUIT BOARD REMOVAL AND REPLACEMENT (CONTROL BOARD, POWER BOARD, AND PROTECTION BOARD) *(continued)*

FIGURE F.66 - PC BOARD REMOVAL



1. PC BOARD COVER
2. PC BOARD ASSEMBLY
3. RETAINER CLIPS

PROCEDURE

1. Remove main input supply power to the machine.
2. With the 3/8" nut driver, remove the 4 screws that hold the handle to the machine.
3. Remove the rubber gasket (cover seal) from the lift bail.
4. With the 5/16" nut driver, remove the sheet metal screws from the case top.
5. With the 5/16" nut driver, remove the screws holding the right and left case sides. Remove the case sides by lifting up and out.
6. Perform the ***Capacitor Discharge Procedure*** described earlier in this section of the manual.

WARNING



Before continuing with the test procedure, perform the capacitor discharge procedure to avoid electric shock.

7. After you have completed the capacitor discharge procedure for all four switch boards, use the 5/16" nut driver to remove the two screws holding the printed circuit board cover in place. Slide the cover forward and lift up to remove it.

Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC

PRINTED CIRCUIT BOARD REMOVAL AND REPLACEMENT (CONTROL BOARD, POWER BOARD, AND PROTECTION BOARD) *(continued)*

⚠ CAUTION

Be sure to follow the recommended static-free methods for handling printed circuit boards. Failure to do so can result in permanent damage to the equipment.

8. Remove the molex plugs from the PC board you are removing.

NOTE: The plugs are numbered in order from left to right.

9. Depress the two PC board retainer clips located on the left and right sides of the board. Lift the board by the clips to remove it.

10. When reinstalling the PC board, make certain the tabs at the bottom of the board fit into the slots on the compartment floor. When the board is properly seated, the retainer clips will snap into the locked position.

11. Install the molex plugs removed earlier. Be sure to fit the each plug into its respective receptacle on the board.

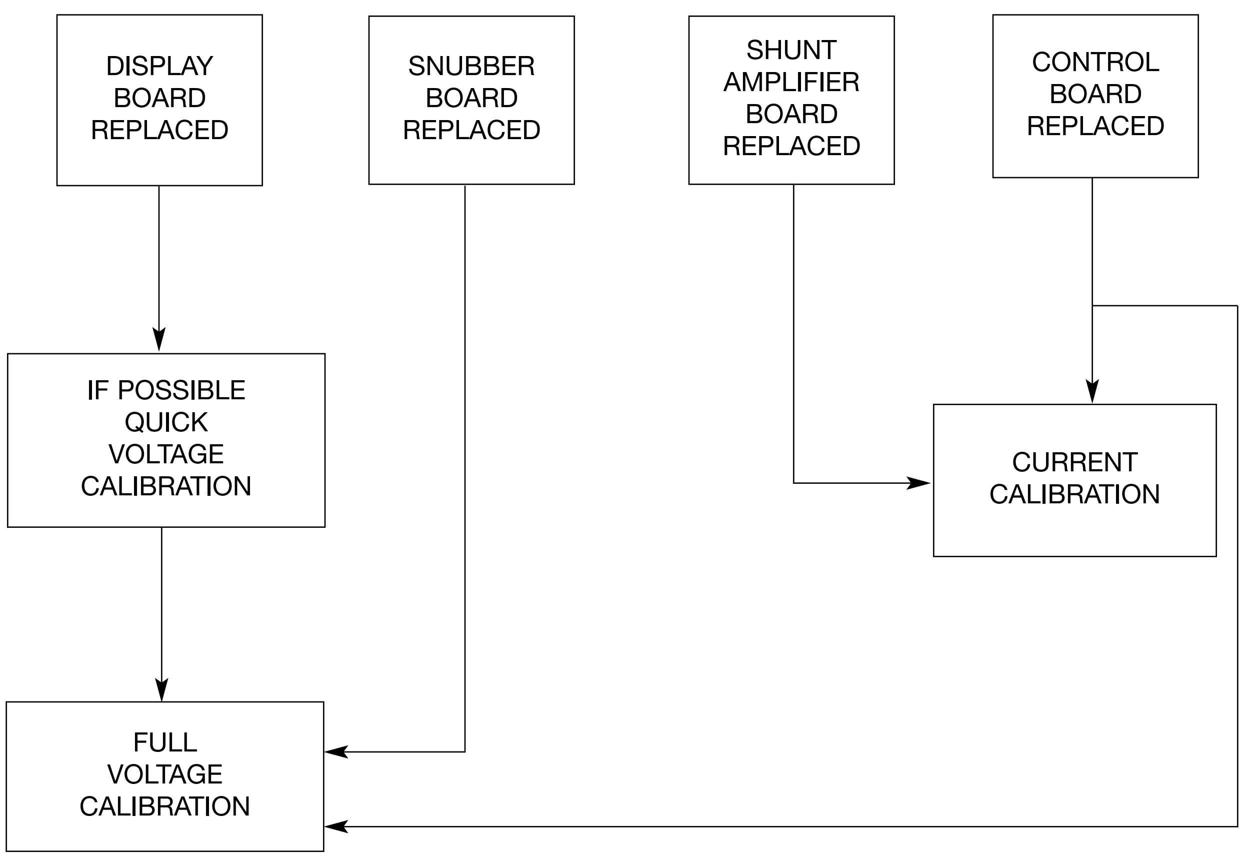
12. Perform appropriate calibration procedure per flowchart in Figure F.67.

13. Install the PC board cover and tighten the two screws with the 5/16" nut driver.

14. Install the machine case sides and top.

15. Install the handle and the lift bail rubber gasket.

FIGURE F.67 – PC BOARD REPLACEMENT CALIBRATION REQUIREMENTS



NOTES

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DISPLAY BOARD REMOVAL AND REPLACEMENT

⚠ WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-800-833-9353 (WELD).

DESCRIPTION

The following procedure will aid the technician in removing the display board for maintenance or replacement.

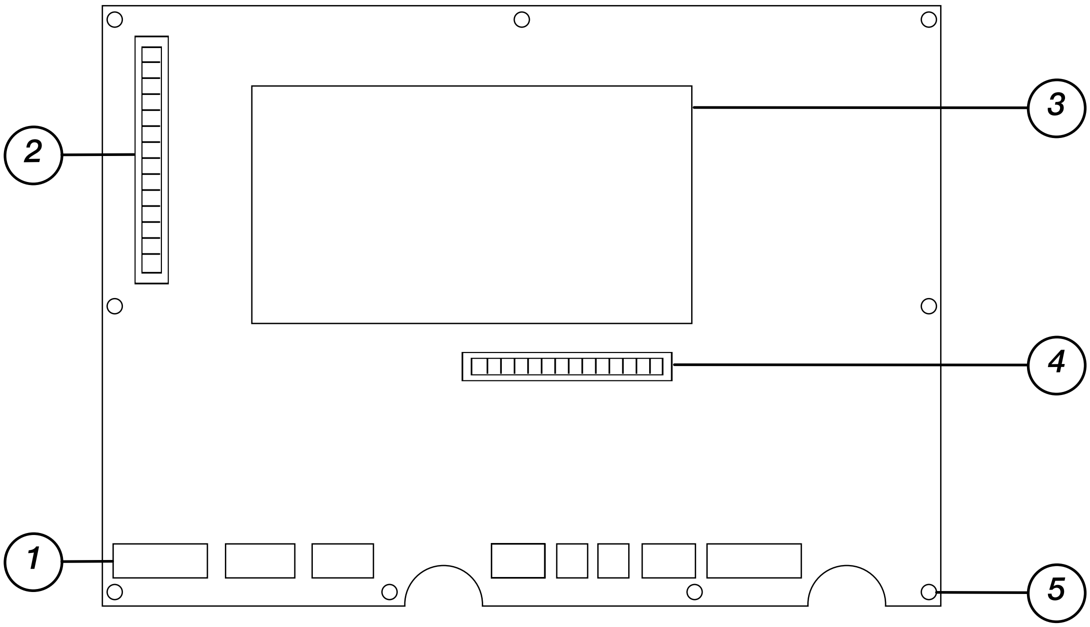
MATERIALS NEEDED

5/16" Nut driver
3/8" Nut driver

This procedure takes approximately 45 minutes to perform.

DISPLAY BOARD REMOVAL AND REPLACEMENT *(continued)*

FIGURE F.68 - DISPLAY BOARD REMOVAL



1. MOLEX PLUG HEADERS (8)
2. KEY PAD RIBBON CONNECTOR
3. LCD DISPLAY WINDOW
4. LCD CONNECTOR
5. MOUNTING PIN HOLE

NOTE: Before changing or disturbing the display board follow the procedure outlined under ***QUICK VOLTAGE CALIBRATION (Fig. F.54)*** in this section.

PROCEDURE

1. Remove main input supply power to the machine.
2. With the 3/8" nut driver, remove the 4 screws that hold the handle to the machine.
3. Remove the rubber gasket (cover seal) from the lift bail.
4. With the 5/16" nut driver, remove the sheet metal screws from the case top.
5. With the 5/16" nut driver, remove the screws holding the right and left case sides. Remove the case sides by lifting up and out.
6. Perform the ***Capacitor Discharge Procedure*** described earlier in this section of the manual.

WARNING



Before continuing with the test procedure, perform the capacitor discharge procedure to avoid electric shock.

CAUTION

Be sure to follow the recommended static-free methods for handling printed circuit boards. Failure to do so can result in permanent damage to the equipment.

7. After you have completed the capacitor discharge procedure for all four switch boards, carefully remove the eight molex plugs from the lower portion of the display board.

DISPLAY BOARD REMOVAL AND REPLACEMENT *(continued)*

8. Carefully remove the key pad ribbon connector from the right side of the display board.
9. Carefully remove the connector to the LCD display.

CAUTION

Do not touch the sensors located on the left side of the display board when you handle it for removal or replacement. Failure to do so can result in permanent damage to the sensors.

---

10. Carefully remove the display board from the its mounting pins. Remove the display board by lifting up and out.
11. Reinstall the display board by carefully pressing it onto its mounting pins. Install the LCD display connector, the key pad connector, and the eight molex plugs that fit along the bottom portion of the display board.
12. After you have installed the display board (a new one or the old one), you must perform the ***Display Board Sensor Calibration Test*** and necessary voltage calibration. Refer to this test in the test portion of this section of the manual.
13. After performing the ***Display Board Sensor Calibration Test***, install the machine case sides and top.
14. Install the handle and the lift bail rubber gasket.

NOTES

Return to Section TOC
Return to Master TOC

Return to Section TOC
Return to Master TOC

MAIN INPUT CONTACTOR (CR1) REMOVAL AND REPLACEMENT

⚠ WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-800-833-9353 (WELD).

DESCRIPTION

The following procedure will aid the technician in removing the main input contactor for maintenance or replacement.

MATERIALS NEEDED

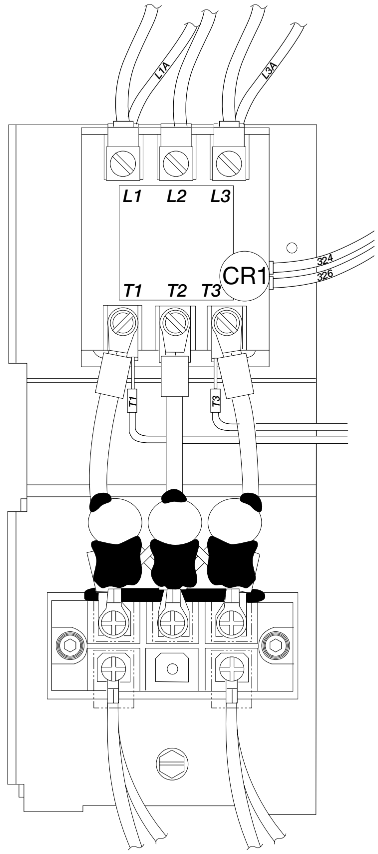
Slot head screw driver
5/16" Nut driver
3/8" Open end wrench
Machine Wiring Diagram in the Electrical Diagrams section of this manual

This procedure takes approximately 45 minutes to perform.

Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC

MAIN INPUT CONTACTOR (CR1) REMOVAL AND REPLACEMENT *(continued)*

FIGURE F.69 - MAIN CONTACTOR



PROCEDURE

1. Remove main input supply power to the machine.
2. With the 3/8" nut driver, remove the 4 screws that hold the handle to the machine.
3. Remove the rubber gasket (cover seal) from the lift bail.
4. With the 5/16" nut driver, remove the sheet metal screws from the case top.
5. With the 5/16" nut driver, remove the screws holding the right and left case sides. Remove the case sides by lifting up and out.
6. Perform the ***Capacitor Discharge Procedure*** described earlier in this section of the manual.

WARNING



Before continuing with the test procedure, perform the capacitor discharge procedure to avoid electric shock.

7. After you have completed the capacitor discharge procedure for all four switch boards, with the slot head screw driver, remove the three heavy leads from the output side of the contactor.
8. With the slot head screw driver, remove the two small leads (L1A and L3A) from the input side of the contactor.

MAIN INPUT CONTACTOR (CR1) REMOVAL AND REPLACEMENT *(continued)*

9. With the slot head screw driver, remove the two small leads (T1 and T3) from the output side of the contactor.
10. With the slot head screw driver, remove the two contactor coil leads (#324 and #326) from the contactor.
11. With the slot head screw driver and 3/8" wrench, loosen the two mounting screws and nuts holding the contactor to the vertical mounting panel.
12. Remove the contactor by lifting up and out.
13. For replacement, mount the contactor to the vertical mounting panel with the two 3/8" mounting screws and nuts.
14. Attach all the contactor leads: coil leads #324 and #326; small leads T1 and T3 to the output side; three heavy leads to the output side; small leads L1A and L3A and three input leads to the input side. Tighten all evenly with the slot head screw driver.
15. Install the machine case sides and top.
16. Install the handle and the lift bail rubber gasket.

NOTES

Return to Section TOC
Return to Master TOC
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Return to Section TOC
Return to Master TOC

OUTPUT RECTIFIER BRIDGE REMOVAL AND REPLACEMENT

⚠ WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-800-833-9353 (WELD).

DESCRIPTION

The following procedure will aid the technician in removing the output rectifier bridge for maintenance or replacement.

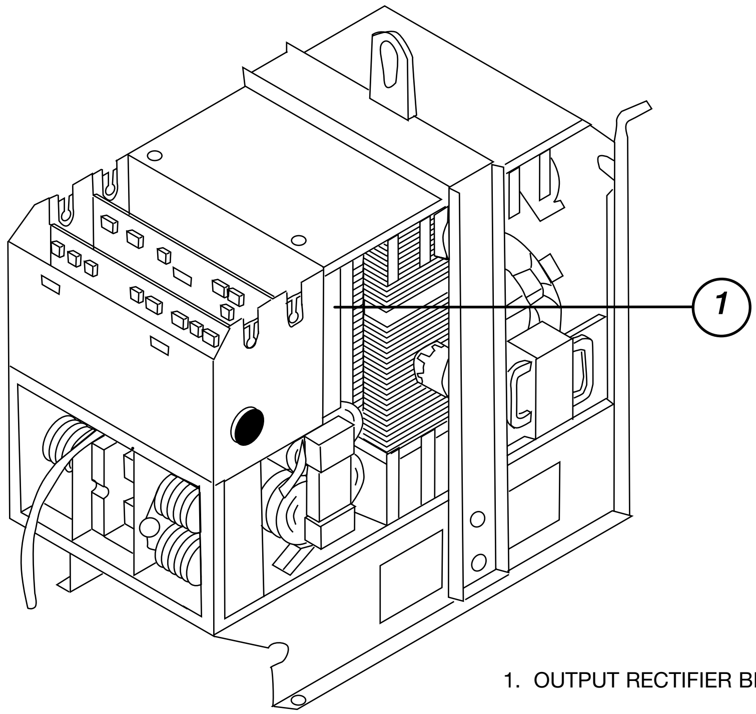
MATERIALS NEEDED

Slot head screw driver
5/16" Nut driver
3/8" Nut driver
7/16" Open end wrench
Wire cutters
Machine Wiring Diagram in the Electrical Diagrams section of this manual

This procedure takes approximately 1 hour 30 minutes to perform.

OUTPUT RECTIFIER BRIDGE REMOVAL AND REPLACEMENT *(continued)*

FIGURE F.70 - OUTPUT RECTIFIER BRIDGE LOCATION



1. OUTPUT RECTIFIER BRIDGE

PROCEDURE

1. Remove main input supply power to the machine.
2. With the 3/8" nut driver, remove the 4 screws that hold the handle to the machine.
3. Remove the rubber gasket (cover seal) from the lift bail.
4. With the 5/16" nut driver, remove the sheet metal screws from the case top.
5. With the 5/16" nut driver, remove the screws holding the right and left case sides. Remove the case sides by lifting up and out.
6. Perform the ***Capacitor Discharge Procedure*** described earlier in this section of the manual.

WARNING



Before continuing with the test procedure, perform the capacitor discharge procedure to avoid electric shock.

7. After you have completed the capacitor discharge procedure for all four switch boards, cut all necessary cable ties (necessary for removal of the output rectifier bridge) on the left side of the machine.
8. Disconnect all necessary leads from the left side of the output rectifier bridge (two heavy and two small leads). Place the fastener hardware back together to avoid loss.

OUTPUT RECTIFIER BRIDGE REMOVAL AND REPLACEMENT *(continued)*

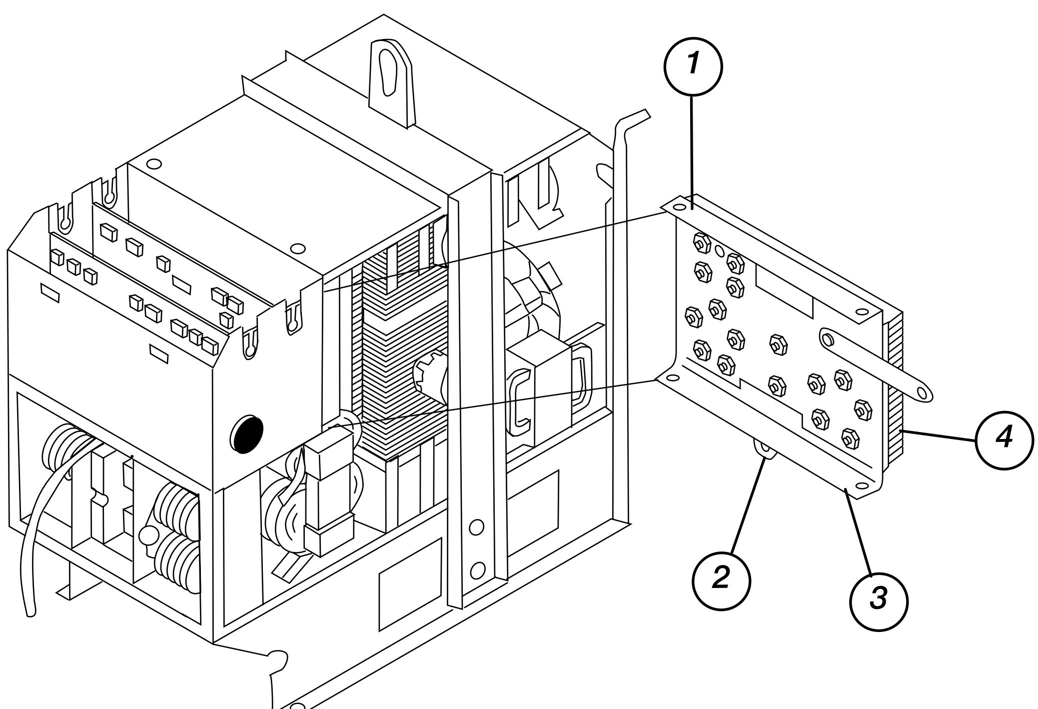
9. Cut all necessary cable ties on the right side of the machine and disconnect all necessary leads (two heavy and two small leads) from the right side of the output rectifier bridge. Place the fastener hardware back together onto the lead ends to avoid loss.

10. On the right side of the machine, use the 7/16" open end wrench to remove the bolt that connects the heat sink at the top to the glastic insulated angle mounting piece. Then remove the carriage bolt that holds the glastic insulated angle mounting piece at the bottom to the subframe. Repeat the same procedure on the left side of the machine. Save the shake-proof washers and nuts for reassembly.

11. With the 7/16" wrench, remove the bolts, top and bottom, that connect the heat sink and glastic insulated angle mounting piece at the middle. With the side bolts already removed, it is easier to access the middle bolts.

12. With the 7/16" wrench, remove the bolt, nut, and split-ring lock washer from the tab connection at the bottom of the heat sink. The input rectifier bridge can now be removed. You may have to bend the bottom tab slightly in order to get it past the main transformer.

FIGURE F.71 – HEAT SINK REMOVAL

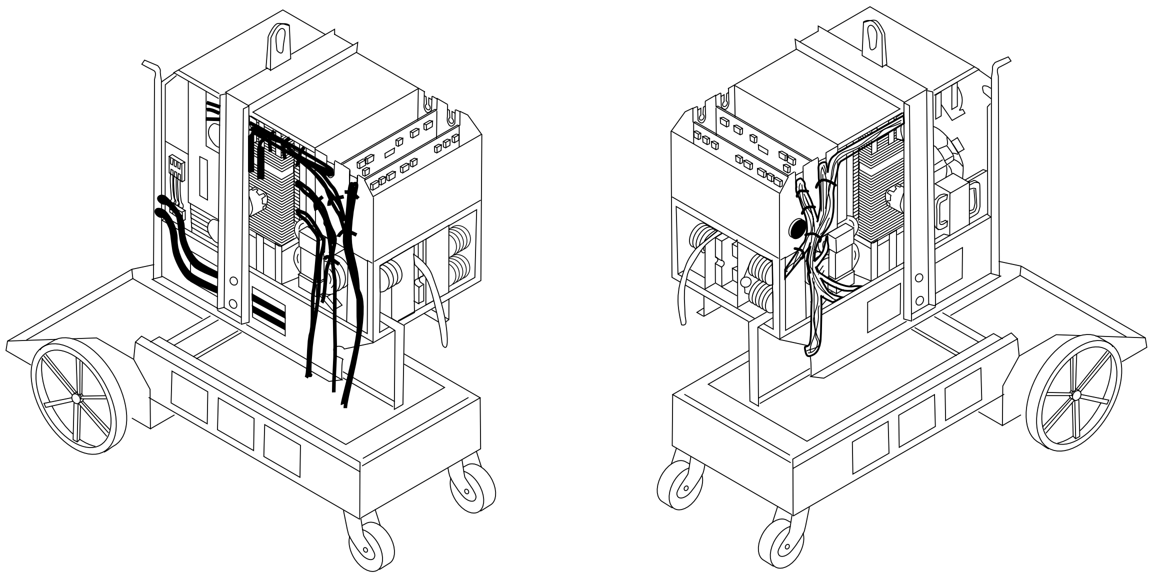


1. GLASTIC INSULATED ANGLE MOUNTING PIECE (TOP)
2. BOTTOM TAB CONNECTION
3. GLASTIC INSULATED ANGLE MOUNTING PIECE (BOTTOM)
4. HEAT SINK

Return to Section TOC
Return to Master TOC

OUTPUT RECTIFIER BRIDGE REMOVAL AND REPLACEMENT *(continued)*

FIGURE F.72 – CABLE TIE LOCATIONS



PRIMARY HARNESS ASSEMBLY (BLACK)

SECONDARY HARNESS ASSEMBLY (WHITE)

13. For reassembly, attach the glastic insulated angle mounting pieces to the heat sink first. Slide the bridge into position and then fasten the bottom tab to the sub-frame with the bolt, split-ring lock washer and nut. Then attach and tighten down the top and bottom bolts that hold the heat sink on both sides of the machine.
14. Reconnect the leads on both sides of the bridge. Install new cable ties according to Figure F.72.
15. Install the machine case sides and top.
16. Install the handle and the lift bail rubber gasket.

FET MODULE REMOVAL AND REPLACEMENT

⚠ WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-800-833-9353 (WELD).

DESCRIPTION

The following procedure will aid the technician in removing the FET modules and main transformer for maintenance or replacement.

MATERIALS NEEDED

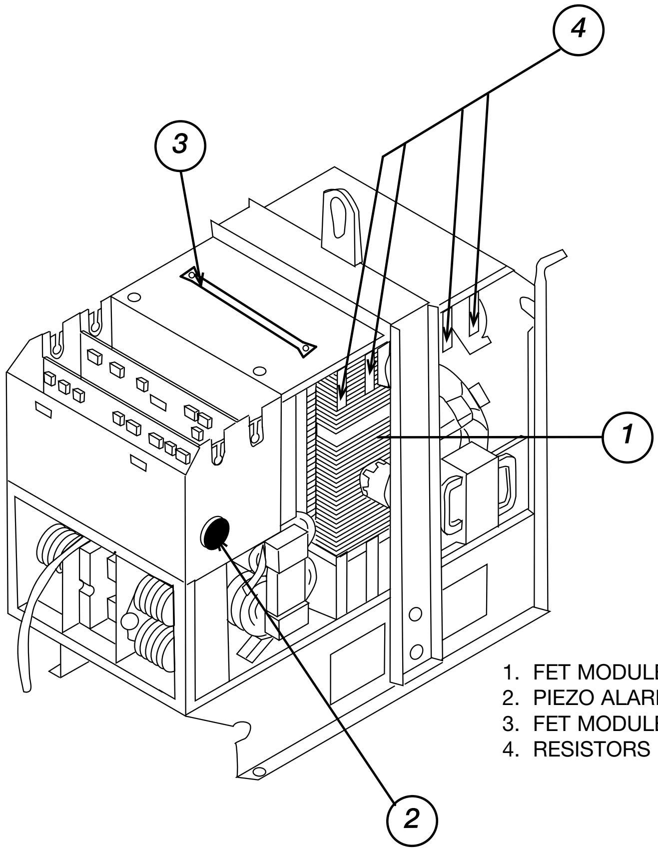
Slot head screw driver
Phillips head screw driver
5/16" Nut driver
3/8" Nut driver
5/16" Open end or box wrench
7/16" Open end or box wrench
3/8" Socket wrench
1/2" Socket wrench
Wire cutters
Machine Wiring Diagram in the Electrical Diagrams section of this manual

This procedure takes approximately 3 hours 30 minutes to perform.

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Return to Master TOC
Return to Section TOC
Return to Master TOC

FET MODULE REMOVAL AND REPLACEMENT *(continued)*

FIGURE F.73 - FET MODULE LOCATION



1. FET MODULE
2. PIEZO ALARM BUZZER
3. FET MODULE LOCKING BAR
4. RESISTORS

PROCEDURE

1. Remove main input supply power to the machine.
2. With the 3/8" nut driver, remove the 4 screws that hold the handle to the machine.
3. Remove the rubber gasket (cover seal) from the lift bail.
4. With the 5/16" nut driver, remove the sheet metal screws from the case top.
5. With the 5/16" nut driver, remove the screws holding the right and left case sides. Remove the case sides by lifting up and out.
6. Perform the ***Capacitor Discharge Procedure*** described earlier in this section of the manual.

WARNING



Before continuing with the test procedure, perform the capacitor discharge procedure to avoid electric shock.

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7. After you have completed the capacitor discharge procedure for all four switch boards, use the 5/16" nut driver to remove the two screws holding the printed circuit board cover in place. Slide the cover forward and lift up to remove it.

CAUTION

Be sure to follow the recommended static-free methods for handling printed circuit boards. Failure to do so can result in permanent damage to the equipment.

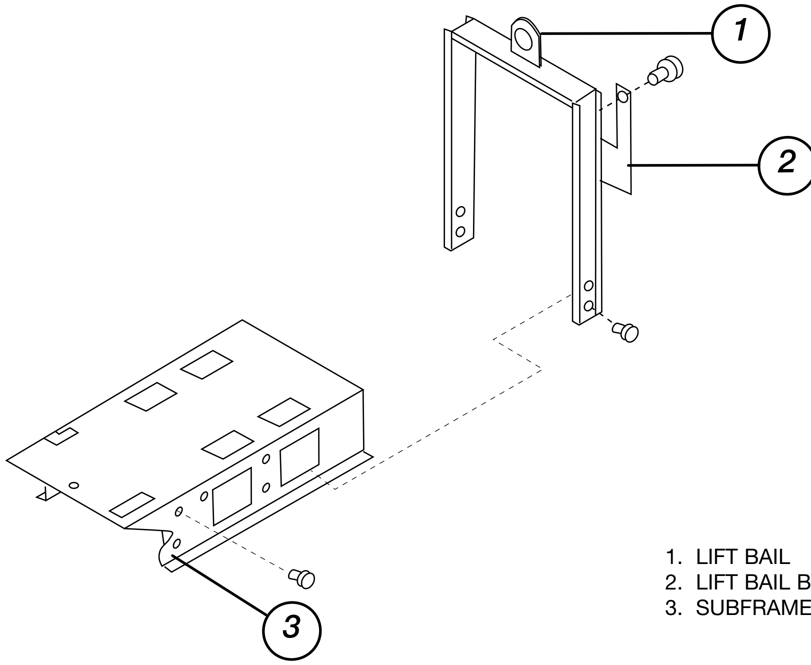
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8. Remove the molex plugs from the PC boards except the display board.

Return to Section TOC
Return to Master TOC

FET MODULE REMOVAL AND REPLACEMENT *(continued)*

FIGURE F.74 - LIFT BAFFLE/BAIL REMOVAL



9. With the wire cutters, cut all necessary cable ties.
10. Disconnect the leads to the output rectifier bridge. Cut all necessary cable ties.
11. Disconnect two plugs from the snubber board.
12. Disconnect the output cable strap and pull it through and free from the lift bail baffle eyelet hole. Cut any necessary cable ties.
13. With the 3/8" nut driver, remove the two screws that hold the lift bail baffle. See Figure F.74. Remove the baffle.
14. With the 1/2" socket wrench, remove the four bolts (two on each side of the machine) from the lift bail. See Figure F.74. Slide the lift bail up and free of the machine.
15. On the right side of the machine, cut any necessary cable ties to free the wiring harness from the subframe.
16. With the Phillips head screw driver, remove the screw that holds the piezo-electric alarm buzzer in place. Cut the cable tie that holds the wire.
17. With the 3/8" wrench, remove the six resistors that are attached to the top of the subframe (four on the top right, two on the top left). Note the physical placement and wiring for reassembly; labeling is recommended. Also loosen the bottom resistors closest to the FET module assembly. This will allow the capacitors to clear the resistors when the FET module assembly slides forward for removal.
18. With the 5/16" nut driver, remove the sheet metal screw holding the ground leads to the right rear of the subframe. On the left side, unclip the cable tie holding the leads. Let the back of the subframe swing out carefully; the harness will support it.
19. With the 5/16" wrench, remove the two sheet metal screws holding the subframe bottom support section. Note the green ground lead on the left side; be sure to reconnect it during reassembly.
20. With the 7/16" wrench, disconnect the heavy current-carrying flat copper strap running from the shunt amplifier to the output rectifier bridge.

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Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC

FET MODULE REMOVAL AND REPLACEMENT *(continued)*

21. Remove the water cooler assembly in order to access the retainer clips that hold the bottom of the FET module assembly in place. (Complete removal of the unit should not be necessary.) Refer to the ***Water Cooler Removal and Replacement Procedure*** in this section of the module.

22. Remove the locking bar from the top of the subframe where it secures the FET module assembly. Depress the top and bottom retainer clips with the slot head screw driver so that the FET module assembly can slide forward.

23. Slowly lift and remove the subframe, making sure no clips, cable ties, or lead connections are still holding it.

24. With the wire cutters, cut all necessary cable ties holding the FET module assembly to the wiring harness. Using needle nose pliers, disconnect the leads attached to the FET module assembly (all red and white leads should remain connected). Refer to the Wiring Diagram to determine which leads should be disconnected. The main transformer and the reconnect module must be free of the FET module assembly. Also disconnect the thermostat lead.

25. Carefully lift the FET module assembly and remove it from the machine.

26. With the FET module assembly removed, the main transformer, background choke, and output choke are now easily accessible. Refer to the ***Main Transformer Removal and Replacement Procedure*** in this section of the module.

Replacement of the FET Module Assembly:

27. Carefully set the assembly into the bottom of the machine. The terminal label should face the front (toward the main transformer).

28. Connect all leads to their appropriate terminals on the assembly. Use the Wiring Diagram for reference.

29. Carefully position the subframe on top of the FET module assembly. Slide the assembly into place so that the retainer clips snap into their slots, top and bottom. Fit the locking bar into place on top of the subframe to secure the FET module assembly.

FET MODULE REMOVAL AND REPLACEMENT *(continued)*

30. Install the water cooler assembly. Refer to the ***Water Cooler Removal and Replacement Procedure*** in this section of the module.

31. With the 7/16" wrench, connect the heavy current-carrying flat copper strap running from the shunt amplifier to the output rectifier bridge. With a 5/16" wrench, install the two sheet metal screws holding the subframe bottom support section. Connect the green ground lead on the left side.

32. Swing the back of the subframe into place. With the 5/16" nut driver, install the sheet metal screw holding the ground leads to the right rear of the subframe. On the left side, clip the cable tie to hold the leads.

33. With the 3/8" wrench, install the six resistors that are attached to the top of the subframe (four on the top right, two on the top left) according to the markings you made during disassembly. Also tighten the bottom resistors closest to the FET module assembly.

34. With the Phillips head screw driver, install the screw that holds the piezo-electric alarm buzzer in place. Replace the cable tie that holds the wire.

35. Slide the lift bail into place. With the 1/2" socket wrench, install the four bolts (two on each side of the machine) to secure the lift bail. With the 3/8" nut driver, install the two screws to secure the lift bail baffle. Feed the output cable strap through the lift bail baffle eyelet hole. Replace any necessary cable ties.

36. Connect the two plugs to the snubber board.

37. Connect the leads to the output rectifier bridge. Replace all necessary cable ties.

38. Install the molex plugs to the PC boards. Refer to ***Figure F.1***, PC Board Connector Locations in this section of the manual.

39. Install the printed circuit board cover with two 5/16" screws.

40. Replace any necessary cable ties for the wiring harness and other leads that were cut during disassembly.

41. Install the machine case sides and top.

42. Install the handle and the lift bail rubber gasket.

43. Prior to applying full input power perform the ***Pre-Power Up Switch Board Test***.

NOTES

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Return to Section TOC
Return to Master TOC

MAIN TRANSFORMER REMOVAL AND REPLACEMENT

WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-800-833-9353 (WELD).

DESCRIPTION

The following procedure will aid the technician in removing the main transformer for maintenance or replacement.

MATERIALS NEEDED

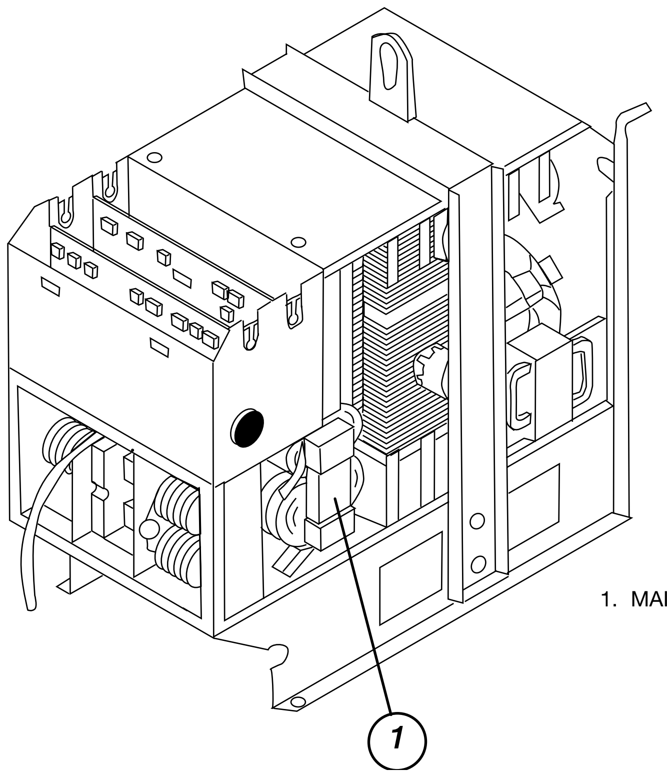
Slot head screw driver
Phillips head screw driver
5/16" Nut driver
3/8" Nut driver
5/16" Open end or box wrench
7/16" Open end or box wrench
3/8" Socket wrench
1/2" Socket wrench
Wire cutters
Machine Wiring Diagram in the Electrical Diagrams section of this manual

This procedure takes approximately 2 hours 30 minutes to perform.

Return to Section TOC
Return to Master TOC

MAIN TRANSFORMER/CHOKE REMOVAL AND REPLACEMENT *(continued)*

FIGURE F.75 - MAIN TRANSFORMER LOCATION



1. MAIN TRANSFORMER

PROCEDURE

1. Remove main input supply power to the machine.
2. With the 3/8" nut driver, remove the 4 screws that hold the handle to the machine.
3. Remove the rubber gasket (cover seal) from the lift bail.
4. With the 5/16" nut driver, remove the sheet metal screws from the case top.
5. With the 5/16" nut driver, remove the screws holding the right and left case sides. Remove the case sides by lifting up and out.
6. Perform the ***Capacitor Discharge Procedure*** described earlier in this section of the manual.

WARNING



Before continuing with the test procedure, perform the capacitor discharge procedure to avoid electric shock.

7. After you have completed the capacitor discharge procedure for all four switch boards, perform the ***FET Module Assembly Removal Procedure***. Refer to the procedure in this section of the manual. After the FET module assembly has been removed, the main transformer and chokes are easily accessible.
8. With the 3/8" socket wrench, remove the four main transformer mounting bolts.
9. Disconnect the heavy leads between the main transformer and the choke assembly. You will need to cut the cable ties on the insulating sleeve and slide the sleeve forward to access the connection.
10. Lift the main transformer out. Remove the background or output chokes if necessary by removing any mounting bolts holding the chokes to the machine frame bottom.
11. After reassembly test on high voltage input and reconnect.

PRE-POWERUP SWITCH BOARD TEST PROCEDURE FOR REPLACEMENT OF SWITCH ASSEMBLY G2402-2

⚠ WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-800-833-9353 (WELD).

DESCRIPTION

The following tests and procedures must be performed if the main power FET module has been replaced in the Power Wave. These tests are necessary to ensure that the FET module has been installed and connected properly.

This procedure takes approximately 2 hours to perform.

BEWARE:

ISOLATED POWER SUPPLIES AND METERING MUST BE USED: CATASTROPHIC PC BOARD DAMAGE WILL OCCUR IF THE VOLTAGE SUPPLIES AND METERING ARE NOT COMPLETELY ELECTRICALLY ISOLATED.

MATERIALS NEEDED

Calibration and Test Overlay	L9660-255
Isolation transformer (for oscilloscope)	
Isolation transformer 115vac @ 3 amps (min)	circuit of figure #1
Isolation transformer 115vac @ 2 amps (min)	circuit of figure #3
Variable transformer 3 amps (min)	
Oscilloscope	
*Current probe	Tektronic P6201 or equivalent
Voltmeters	
Fuse 5 amps (2).	
P70 adapter	
Female connector	S18247-6
Male connector	S18249-6
Male pin	S8053-122
Female pin	S8053-123
P23 adapter	
Male connector	S18247-6
Female pin	S8053-123
Toggle switch (SPST)	

*An alternate method of testing using an isolated oscilloscope may be used.

PRE-POWERUP SWITCH BOARD TEST PROCEDURE FOR REPLACEMENT OF SWITCH ASSEMBLY G2402-2 *(continued)*

FILTER CAPACITOR POLARITY TEST

1. Perform this procedure with the input power removed. Perform the ***CAPACITOR DISCHARGE Procedure*** to remove any charge from the input filter capacitors.

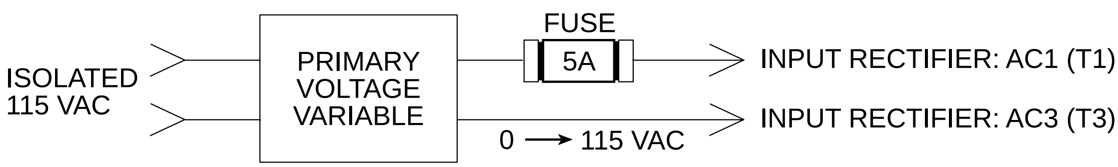
2. Configure the machine for 230VAC operation.

3. Attach the ohmmeter (set to 1 K ohm range) across one of the 7.5K ohm bleeder resistors (R9 or R10). See wiring diagram.

4. Attach the positive meter probe to wire #9 and the negative meter probe to lead #12. The resistance should slowly increase to a value between 3K ohms and 3.5K ohms.

5. Repeat the procedure for the other bleeder (7.5K ohm) resistor.

FIGURE F.76 - AC SUPPLY LEADS



SETUP THE POWER WAVE FOR PRETEST

1. Turn the input power switch to the OFF position.
2. Unplug P73. See wiring diagram.
3. Install the L9660-255 Calibration & Test overlay into the Power Wave.
4. Construct an isolated variable AC supply circuit as shown in Figure F.76 using the following equipment:
   Isolation transformer 115vac @ 3 amps.
   5 amp Variac.
   5 amp Fuse.
5. Connect the variable AC supply leads to the Power Wave input rectifier terminals AC1 (T1), and AC3 (T3). See Figure F.76. Make certain the variac is at zero volts output.

⚠ WARNING

ALL AC SUPPLIES MUST BE ELECTRICALLY ISOLATED (Isolation transformers). THE PRINTED CIRCUIT BOARDS WILL BE DAMAGED IF THE AC SUPPLIES ARE NOT ISOLATED.

6. Monitor the filter capacitor voltage as per ***Figure F.77***.

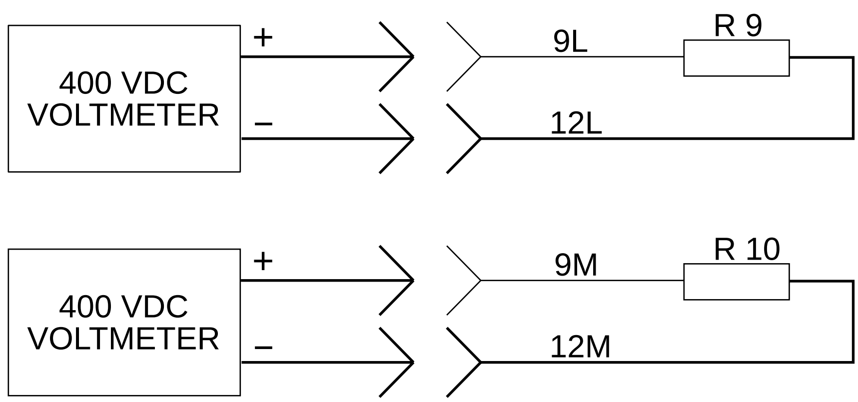
⚠ WARNING

WARNING: ALL METERS AND OSCILLOSCOPES MUST BE ELECTRICALLY ISOLATED (Isolation transformers).

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PRE-POWERUP SWITCH BOARD TEST PROCEDURE FOR REPLACEMENT OF SWITCH ASSEMBLY G2402-2 *(continued)*

FIGURE F.77 - FILTER CAPACITOR VOLTAGE



⚠ WARNING

MAKE SURE FILTER CAPACITORS ARE DISCHARGED

1. Construct a 115VAC pretest power supply as per ***Figure F.78*** using the following:

   Switch (SPST)
   Fuse (5 amp max)
   P70 adapter

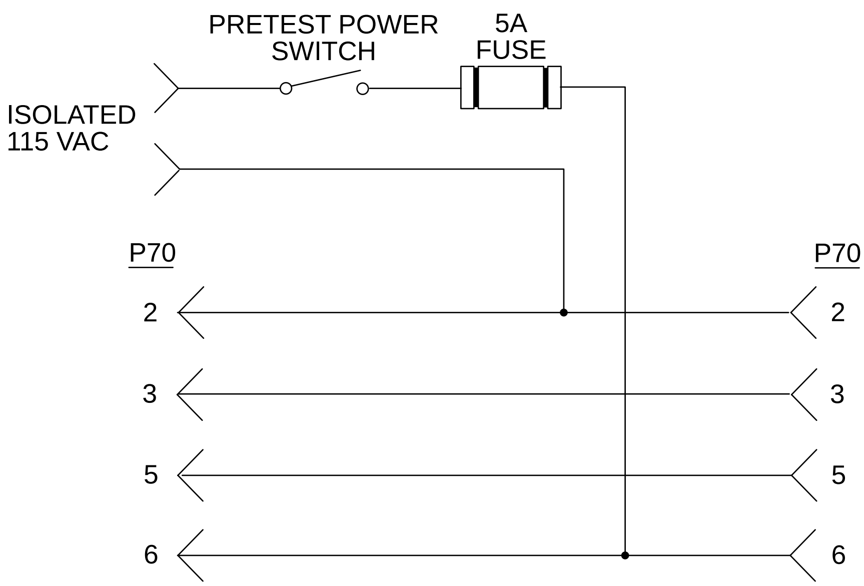
⚠ WARNING

ALL AC SUPPLIES MUST BE ELECTRICALLY ISOLATED (isolation transformers). THE PRINTED CIRCUIT BOARDS WILL BE DAMAGED IF THE AC SUPPLIES ARE NOT ISOLATED.

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PRE-POWERUP SWITCH BOARD TEST PROCEDURE FOR REPLACEMENT OF SWITCH ASSEMBLY G2402-2 *(continued)*

FIGURE F.78 - PRETEST POWER SUPPLY



Connect the pretest power supply to plug P70 as per Figure F.78. See wiring diagram.

ARC START PW450 WITH WIREFEEDER
The arc start may be initiated by any of the following methods:

1. Release wire tension and pull gun trigger.
2. Jumper pins C and D on wire feeder input connector.
3. Jumper pins D and E on front panel amphenol connector near welding output terminals.

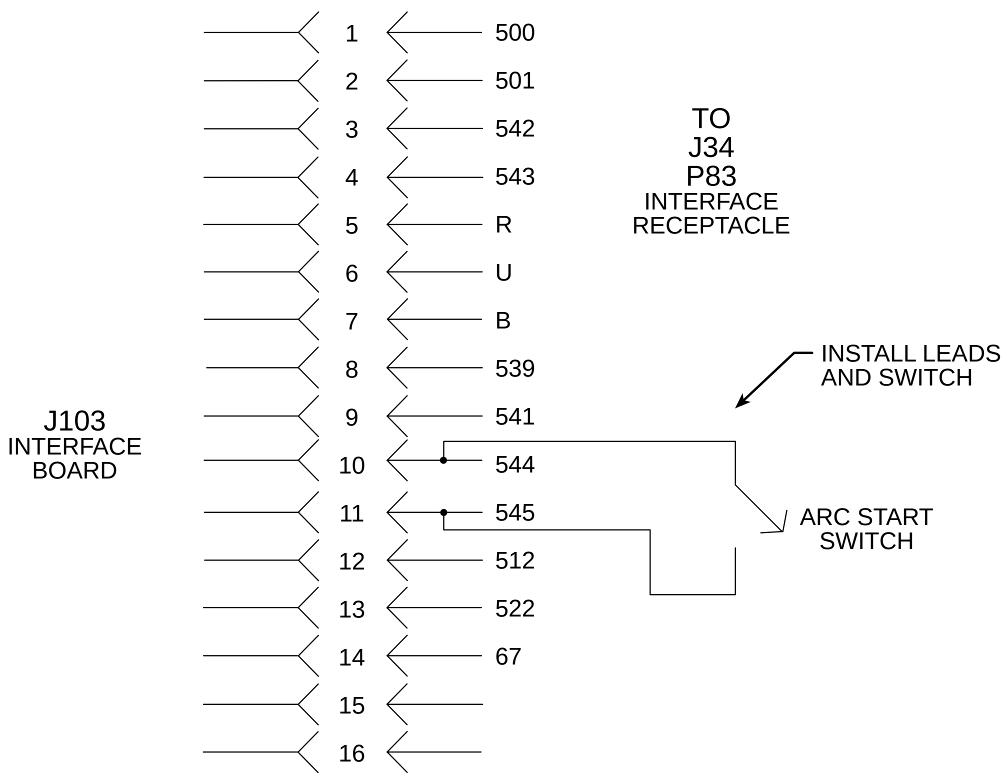
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PRE-POWERUP SWITCH BOARD TEST PROCEDURE FOR REPLACEMENT OF SWITCH ASSEMBLY G2402-2 *(continued)*

ARC START FOR PW450 ROBOTIC

1. Construct and connect an arc start circuit as per Figure F.79.
2. Install leads and an arc start switch into plug J103 pin 10 to pin 11 on the interface PC board. Make sure the arc start switch leads are long enough to reach outside of the machine case.
3. Leave plug J103 connected to the interface board.

FIGURE F.79 - SHUNT CONNECTIONS



PRETEST MACHINE CONNECTIONS

1. Make sure the machine shunt connections are tight.
2. Connect the Power Wave output terminals to a grid load.
3. Turn the grid OFF.

PRETEST POWERUP

1. Turn on the pretest power switch. See ***Figure F.78.*** The Power Wave should beep and display “SELECT A FUNCTION”.

THERMOSTAT TEST

1. Check the thermostat LED (upper right hand corner of the Power Wave Display Panel) it should be OFF.
2. Remove one wire from the output diode heat sink thermostat. The thermostat LED should turn ON. See Wiring Diagram
3. Reconnect the wire to the output diode heat sink thermostat. The thermostat LED should turn back OFF.
4. Turn off the pretest power switch See ***Figure F.78.***

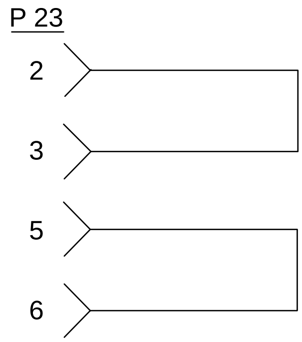
FET DRIVE TEST

Construct plug jumper as per ***Figure F80.***

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PRE-POWERUP SWITCH BOARD TEST PROCEDURE FOR REPLACEMENT OF SWITCH ASSEMBLY G2402-2 *(continued)*

FIGURE F.80 - PC BOARD RECEPTACLE



1. Unplug P23 and insert jumper plug into PC board receptacle. See Figure F.80.
2. Turn ON the preset power switch. See ***Figure F.78.***
3. Press the MANUAL PROCEDURE ENTRY (64) key on the Calibration & Test overlay and using the arrow keys (100) and (101) change the Power Wave to "Process 1 Setup 1-1" mode.
4. Set the Oscilloscope for:
   20 V/div.
   20 uS/div.
5. Turn ON the arc start switch. See ***Arc Start PW450 with wire Feeder*** or ***Figure F.79***.
6. Attach the oscilloscope probes to each of the following eight test points. Each test point should look like the oscilloscope picture in ***Figure F.81.***

⚠ WARNING

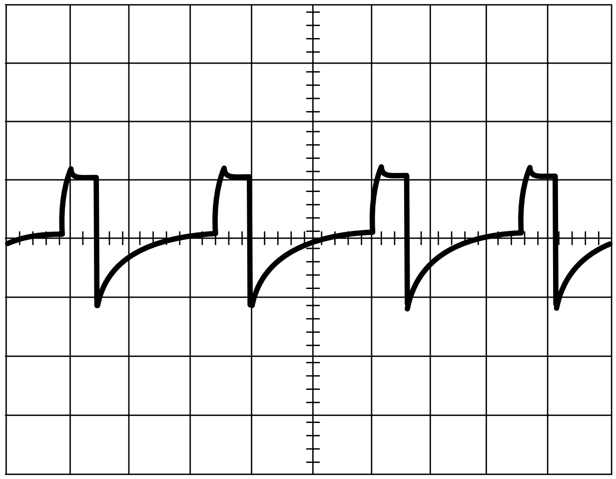
ALL METERS AND OSCILLOSCOPES MUST BE ELECTRICALLY ISOLATED (isolation transformer).

POSITIVE PROBE	NEGATIVE PROBE
#1 P40 pin 14	P40 pin 16
#2 P40 pin 9	P40 pin 11
#3 P40 pin 6	P40 pin 8
#4 P40 pin 1	P40 pin 3
#5 P41 pin 15	P41 pin 16
#6 P41 pin 9	P41 pin 10
#7 P41 pin 7	P41 pin 8
#8 P41 pin 1	P41 pin 2

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PRE-POWERUP SWITCH BOARD TEST PROCEDURE FOR REPLACEMENT OF SWITCH ASSEMBLY G2402-2 *(continued)*

FIGURE F.81 - FET DRIVE SIGNAL



SNUBBER SIGNAL TEST

1. Adjust the grid for a "light" load.
2. Turn ON the variable AC supply applied to the primary circuit. See ***Figure F.76***.
3. Slowly increase the voltage until the filter capacitor voltage is 25VDC. See ***Figure F.77***.
4. Adjust the grid load to get 5 amps output from the Power Wave. **DO NOT PULL MORE THAN 7-8 AMPS OUTPUT FROM THE POWER WAVE.**
5. Set the Oscilloscope for:
   5 V/div/
   20 uS/div.
6. Attach the oscilloscope to each of the following eight test points. Each test point should look like the oscilloscope picture in ***Figure F.82***.

⚠ WARNING

ALL METERS AND OSCILLOSCOPES MUST BE ELECTRICALLY ISOLATED Isolated Transformer).

	POSITIVE PROBE	NEGATIVE PROBE
R1	12E or 12L	401
R2	402	9E or 9L
R3	12F	403
R4	404	9F
R5	405	12G or 12M
R6	406	9G or 9M
R7	12H	407
R8	408	9H

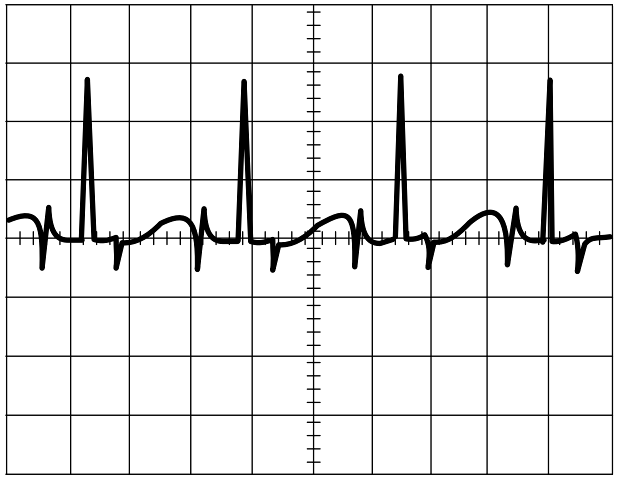
Turn the variable AC primary supply to zero volts and then turn it OFF. See ***Figure F.76***.

Once the filter capacitor voltage drops to zero, turn the arc start switch OFF. See ***Figure F.79.***

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PRE-POWERUP SWITCH BOARD TEST PROCEDURE FOR REPLACEMENT OF SWITCH ASSEMBLY G2402-2 *(continued)*

FIGURE F.82 - SNUBBER SIGNAL



460VAC RECONNECT

1. Reconfigure the machine for 460VAC operation.
2. Turn ON the variable AC supply applied to the primary circuit. See ***Figure F.76***.
3. Turn on the arc start switch. See ***Arc Start PW450*** or ***Figure F.79.***
4. Slowly increase the voltage until filter capacitor voltage is 25VDC. NOTE: Monitor both capacitor voltages. If the two voltages are not within 5 to 8 VDC of each other STOP and check wiring to the FET switch board assembly and also the individual switch boards. See ***Figure F.77.***
5. Adjust the grid load to get 5 amps output from the Power Source. **DO NOT PULL MORE THAN 7-8 AMPS OUTPUT FROM THE POWER WAVE.**
6. Repeat the previous ***Snubber Signal Test*** by checking the eight test points.

OUTPUT SIGNAL TEST

1. Make certain the machine is configured for 460VAC operation.
2. Turn ON the variable AC supply applied to the primary circuit. See ***Figure F.76.***
3. Turn ON the arc start switch. See ***Arc Start PW450 or Figure F.79.***
4. Slowly increase the voltage until the filter capacitor voltage is 25VDC. See ***Figure F.77.***
5. Adjust the grid load to get 5 amps output from the Power Wave. **DO NOT DRAW MORE THAN 7-8 AMPS OUTPUT FROM THE POWER WAVE.**
6. Set the Oscilloscope for:
   5 V/div.
   10 uS/div.

⚠ WARNING

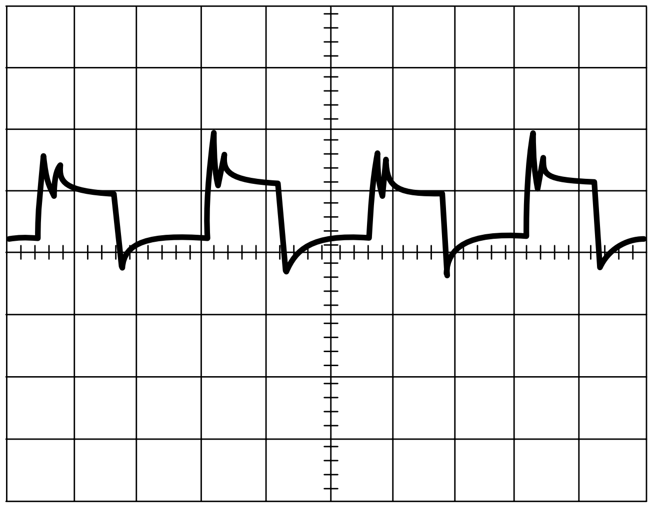
ALL METERS AND OSCILLOSCOPES MUST BE ELECTRICALLY ISOLATED.

7. Connect the positive oscilloscope probe to the Power Wave positive welding output terminal and the negative probe to the negative welding output terminal. The output should look like the oscilloscope picture in ***Figure F.83.***

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PRE-POWERUP SWITCH BOARD TEST PROCEDURE FOR REPLACEMENT OF SWITCH ASSEMBLY G2402-2 *(continued)*

FIGURE F.83 - OUTPUT SIGNAL



8. Turn the variable AC primary supply to zero volts and then turn it OFF. See ***Figure F.76.***

9. Once the filter capacitor voltage drops to zero, turn the arc start switch OFF. See ***Arc Start PW450 or Figure F.79.***

PREPARE MACHINE FOR NORMAL OPERATION

1. Turn OFF the 115VAC pretest power circuit. See ***Figure F.78***

2. Make certain the filter capacitors are completely discharged. Remove the variable AC primary supply. See ***Figure F.76.***

3. Remove the 115VAC pretest power circuit. See ***Figure F.78.***

4. Reconnect plug P70.

5. Remove the jumper plug in P23. See ***Figure F.80***

6. Reconnect P23.

7. Reconnect P73.

OUTPUT TESTS SETUP

The filter capacitors must be discharged before continuing. Make sure the Power Wave is configured for 460VAC operation.

1. Connect a power input cable to CR1. **DO NOT APPLY INPUT VOLTAGE AT THIS TIME.**

2. Connect the grid load to the Power Wave output terminals. Make sure the grid load is OFF.

PRIMARY OVER CURRENT TEST

1. Connect a current probe to the oscilloscope and set it for:
   10 mV/div. (should be equal 10 mA/div.)
   10 uS/div.

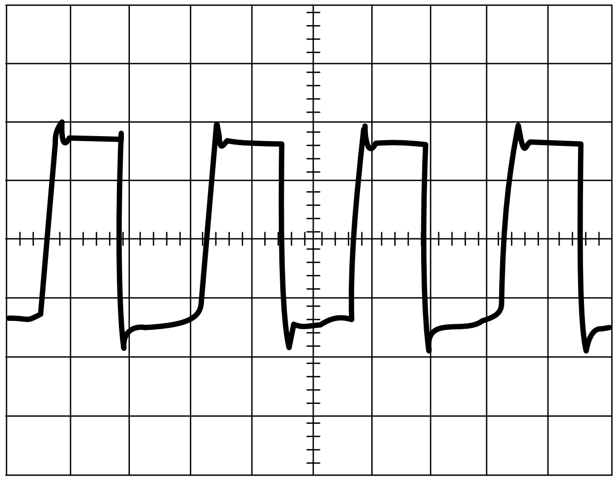
2. Put the current probe on lead 221 at J21 pin 1. See Wiring Diagram

3. Loosely assemble the sheet metal case to the Power Wave.

4. Apply input power to the machine and turn the Power Wave power switch ON.

PRE-POWERUP SWITCH BOARD TEST PROCEDURE FOR REPLACEMENT OF SWITCH ASSEMBLY G2402-2 *(continued)*

FIGURE F.84 - PRIMARY CURRENT SIGNAL



5. Press the MANUAL PROCEDURE ENTRY Key on the Calibration and Test Overlay and change the Power Wave to “Process 1 Setup 1 -8” mode.
6. Turn the arc start switch ON. See ***Arc Start PW450 or Figure F.79.***
7. Adjust the output grid load to get 400 amps at 36VDC. The oscilloscope picture should look like Figure F.84.

***ALTERNATE TEST (without current probe)**

1. Connect a ***transformer isolated*** oscilloscope as follows:
   Set oscilloscope for .2v/div and 10us/div
   Probe J21 pin 1 wire #211
   Common J21 pin 5 wire #215
2. Observe a waveform similar to Figure F.84. Equal amplitude and symmetry of the pulses is important.
3. Check the capacitor voltages. The capacitor voltages must be within eight volts of each other.
4. Turn the arc start switch OFF. See ***Arc Start PW450 or Figure F.79***
5. Turn OFF the Power Wave and remove the input power. Make sure the filter capacitors are completely discharged. See ***Figure F.77.***

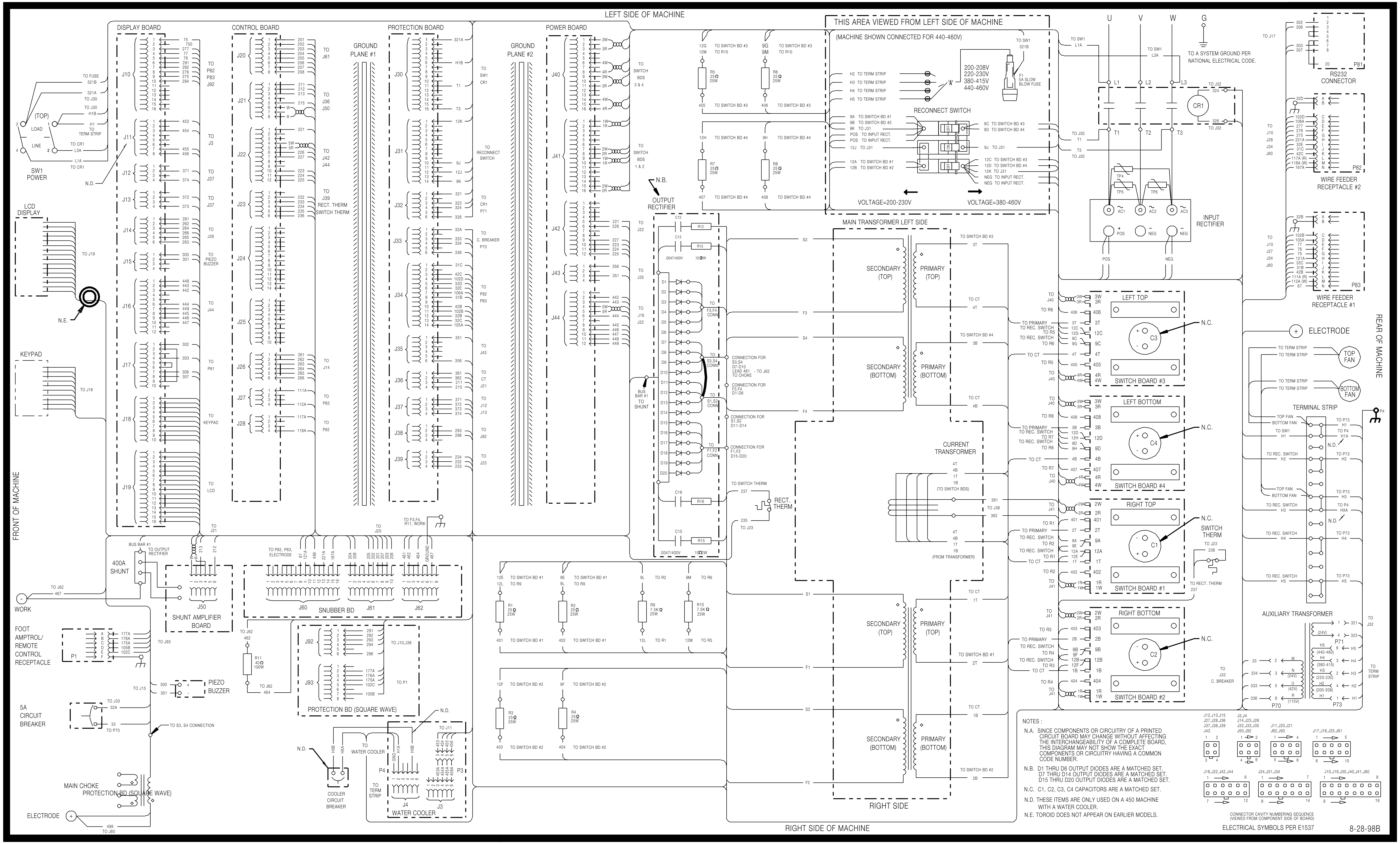
PREPARE MACHINE FOR NORMAL OPERATION.

1. Turn the power switch OFF and remove input power to the machine.
2. The input capacitors must be discharged before continuing.
3. Remove the capacitor voltage monitoring leads. See ***Figure F.77.***
4. Remove the power input cable from CR1.
5. Remove the output cables from the Power Wave.
6. Remove the arc start switch circuit.
7. Enable the water cooler if it was enabled at the start of this test.

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WIRING DIAGRAM - POWER WAVE 450

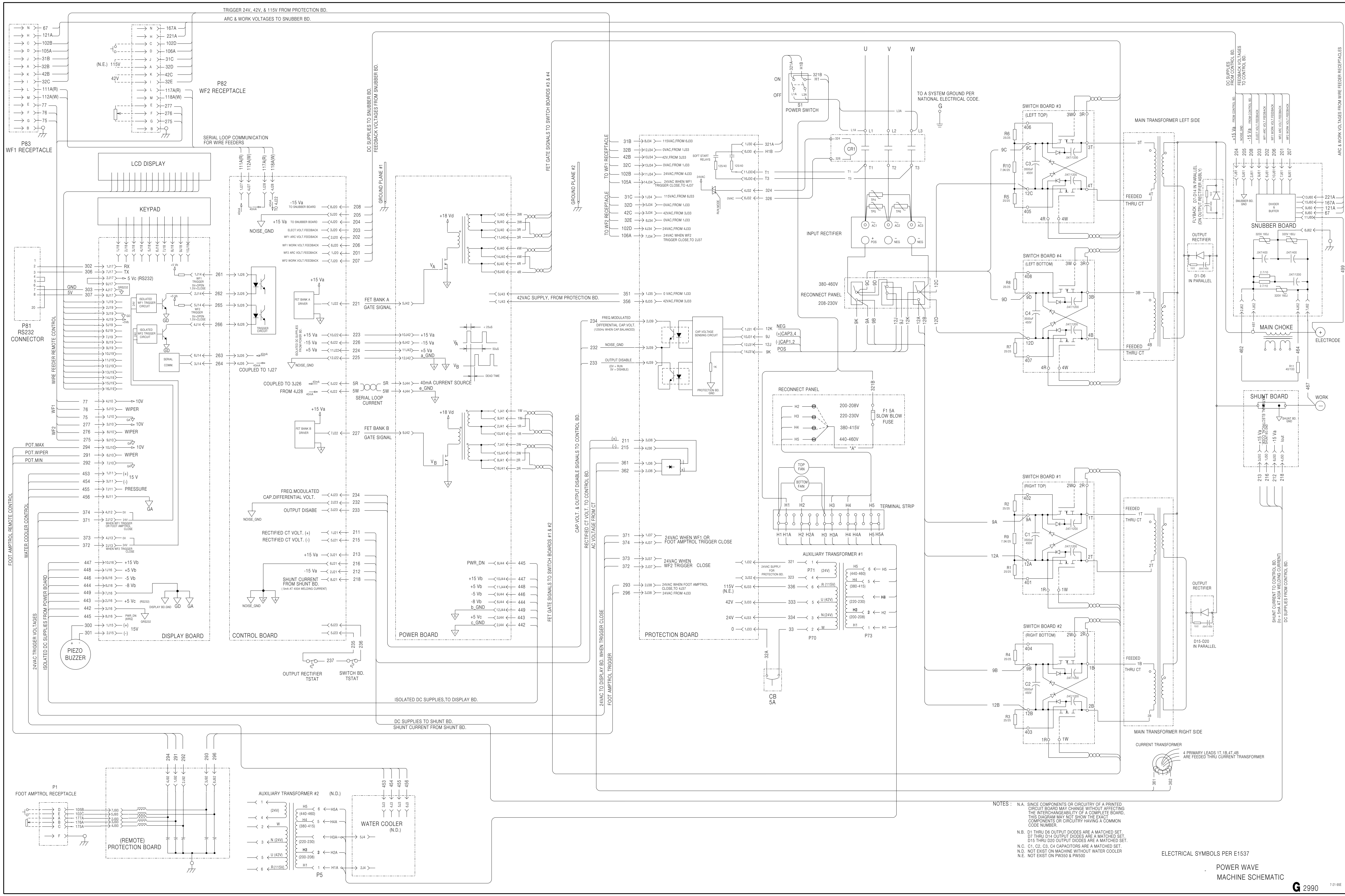


G3617-1

NOTE: This diagram is for reference only. It may not be accurate for all machines covered by this manual. The wiring diagram specific to your code is pasted inside one of the enclosure panels of your machine.

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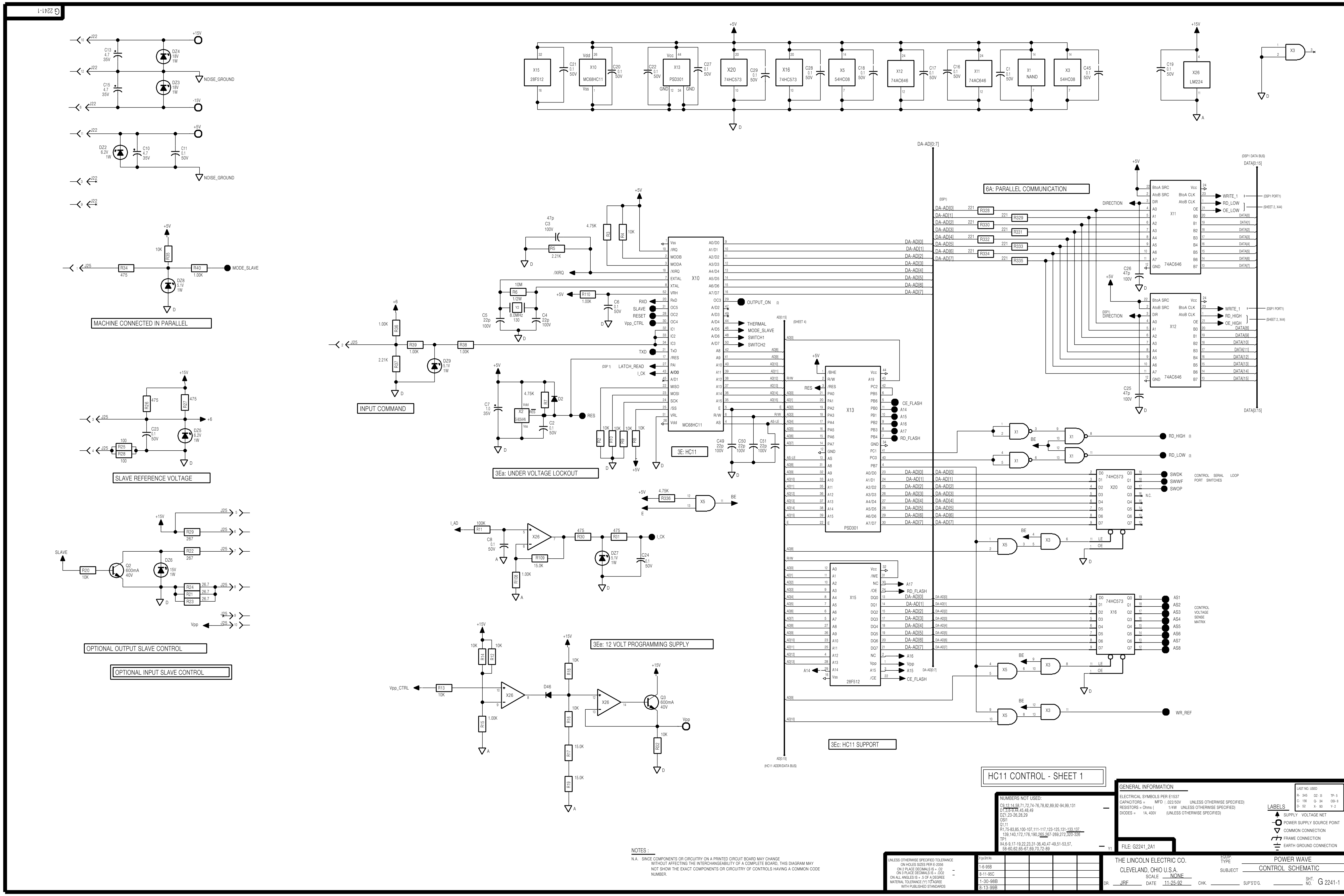
SCHEMATIC - COMPLETE MACHINE



NOTE: This diagram is for reference only. It may not be accurate for all machines covered by this manual.

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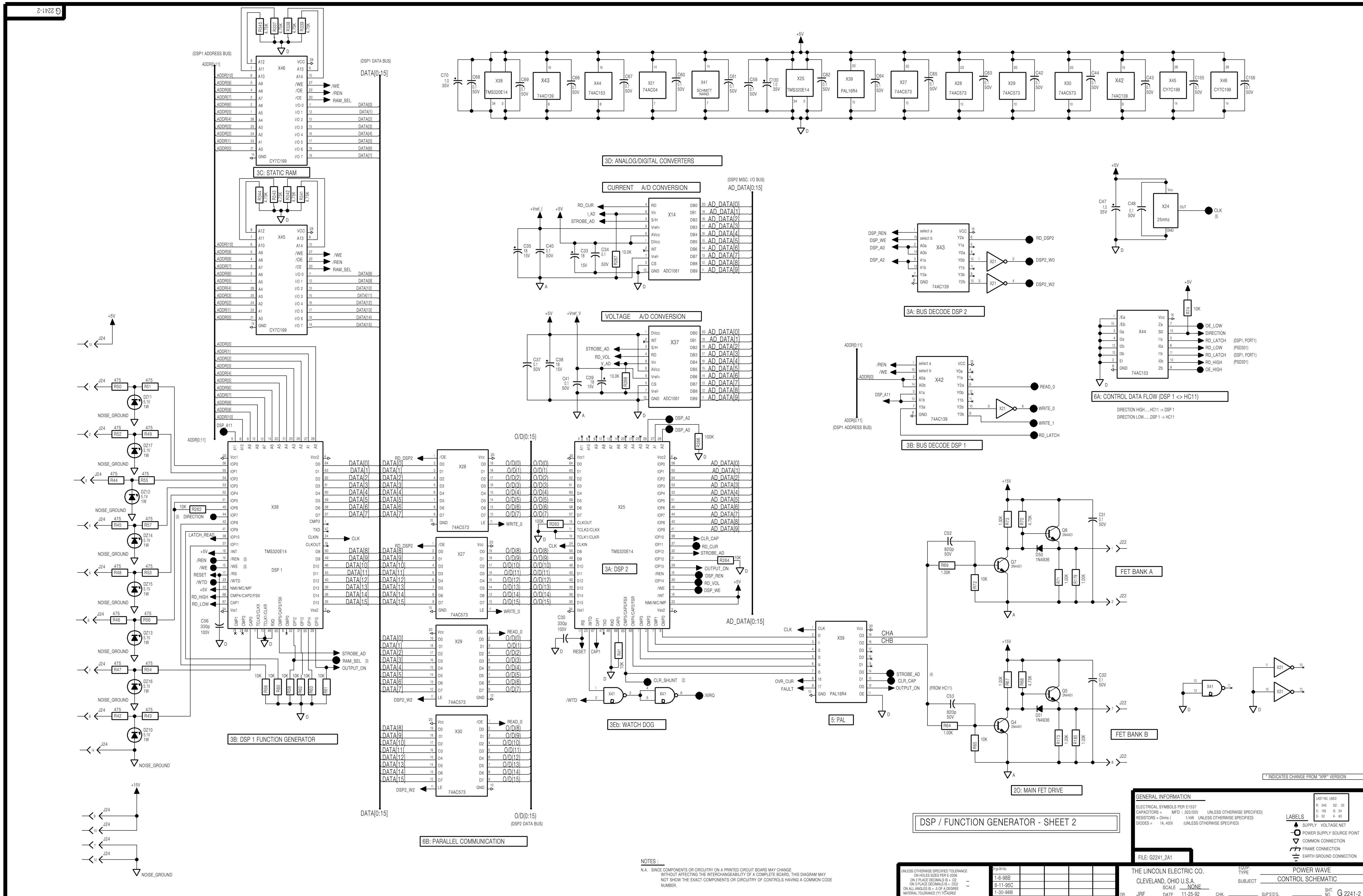
SCHEMATIC - CONTROL PC BOARD #1



NOTE: This diagram is for reference only. It may not be accurate for all machines covered by this manual.

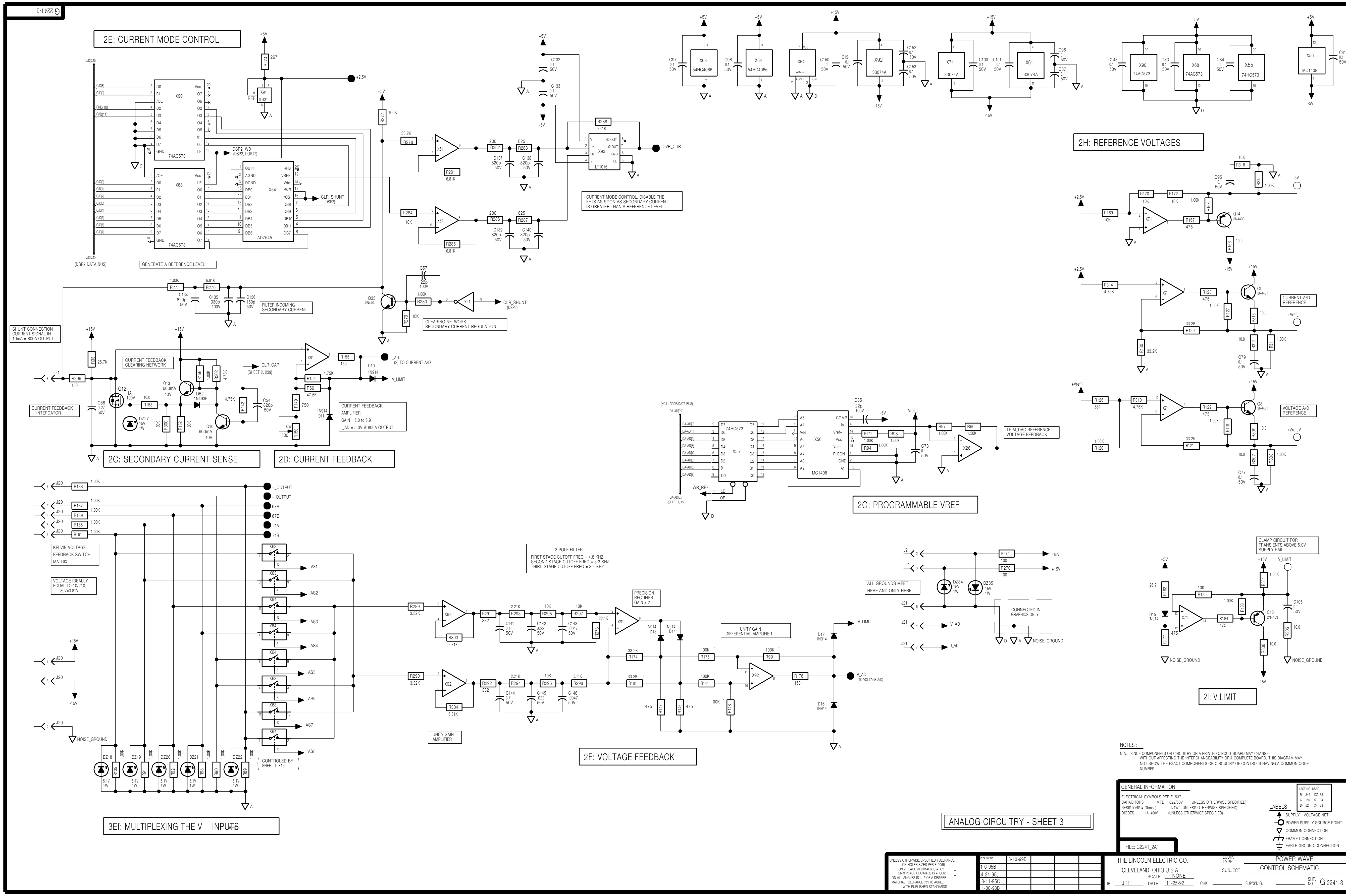
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SCHEMATIC - CONTROL PC BOARD #2



NOTE: This diagram is for reference only. It may not be accurate for all machines covered by this manual.

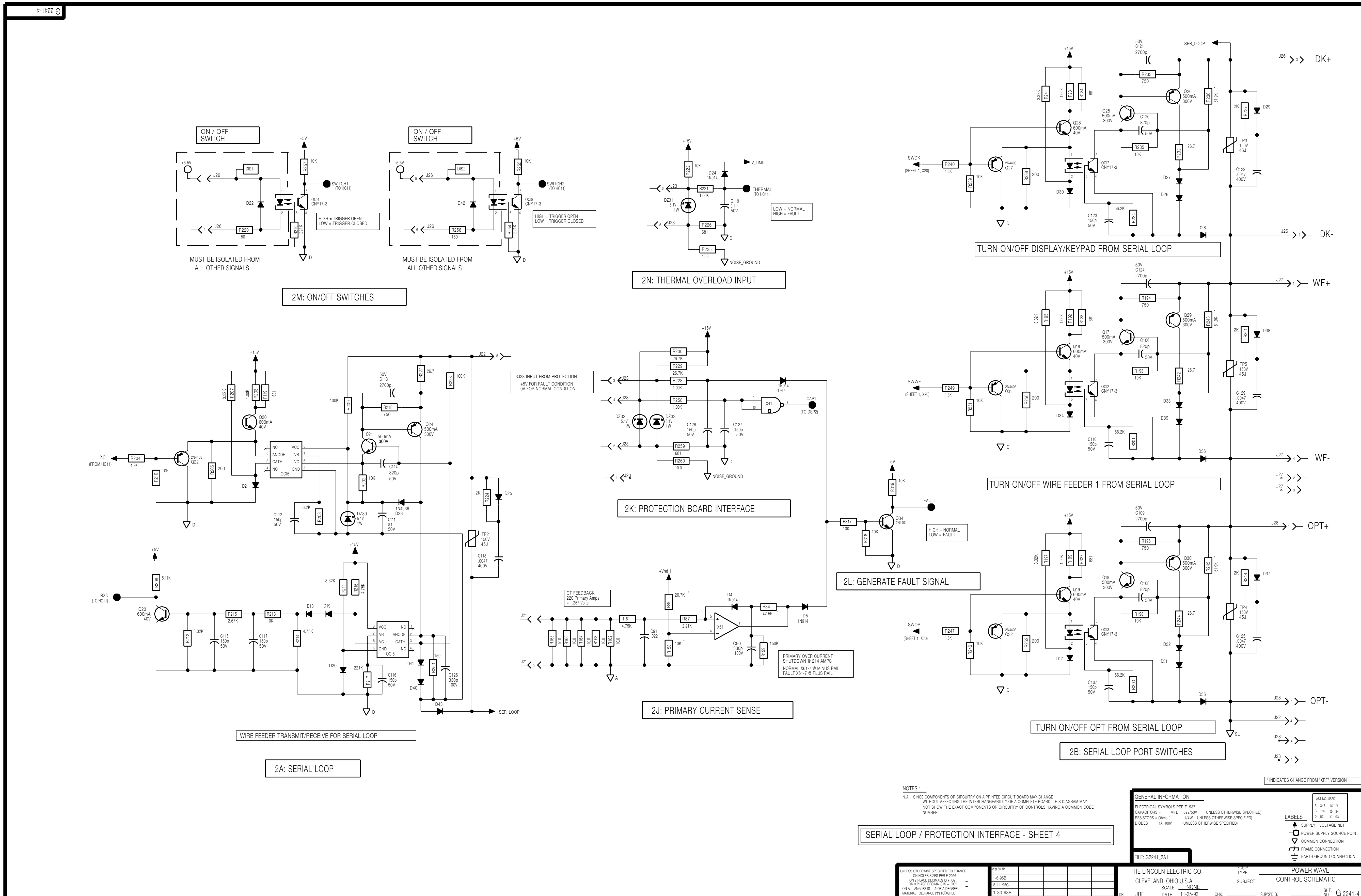
SCHEMATIC - CONTROL PC BOARD #3



NOTE: This diagram is for reference only. It may not be accurate for all machines covered by this manual.

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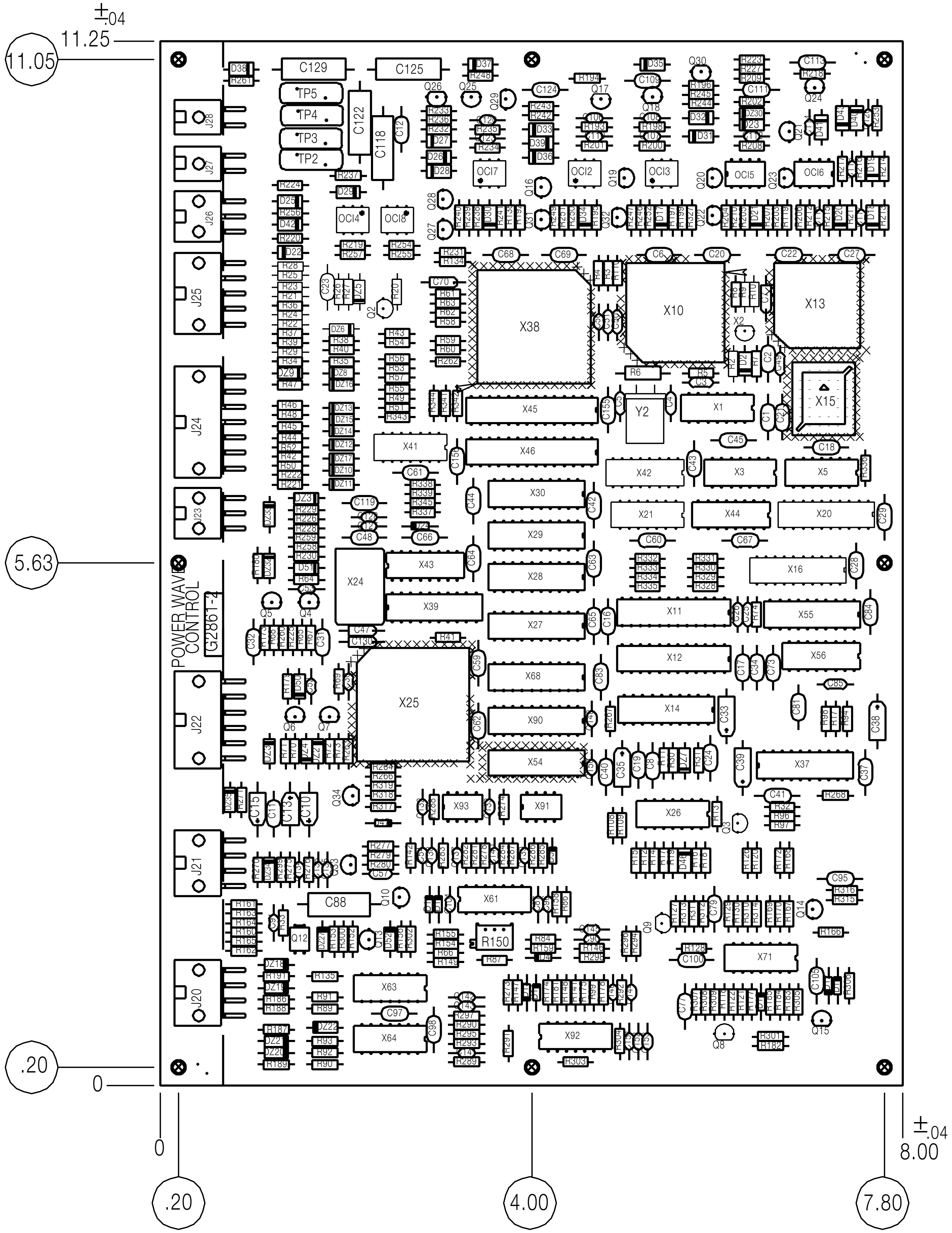
SCHEMATIC - CONTROL PC BOARD #4



NOTE: This diagram is for reference only. It may not be accurate for all machines covered by this manual.

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PC BOARD ASSEMBLY-CONTROL



ITEM	REQ'D	PART NO.	DESCRIPTION
R150	1	S24073-2	500,1/2W,TRIMMER
R153,R160,R162,R163,R164 R165,R166,R225,R260,R305 R306,R307,R309,R312,R313 R316	16	S19400-10R0	10 1/4W
R155,R178,R220,R253,R256 R299	6	S19400-1500	150 1/4W
R159	1	S19400-1503	150K 1/4W
R195,R197,R207,R211,R212 R241,R289,R290	8	S19400-3321	3.32K 1/4W
R200,R201,R208,R234	4	S19400-5622	56.2K 1/4W
R204,R240,R247,R249	4	S19400-1301	1.3K 1/4W
R205,R238,R250,R252,R282 R286	6	S19400-2000	200 1/4W
R206,R298	2	S19400-5111	5.11K 1/4W
R215	1	S19400-2671	2.67K 1/4W
R217,R219,R254,R288	4	S19400-2213	221K 1/4W
R224,R237,R248,R261	4	S19400-2001	2.0K 1/4W
R236,R243,R245	3	S19400-6192	61.9K
R273	1	S19400-2212	22.1K 1/4W
R276,R281,R285,R303,R304	5	S19400-6811	6.81K 1/4W
R283,R287	2	S19400-8250	825 1/4W
R291,R292	2	S19400-3320	332 1/4W
R328,R329,R330,R331,R332 R333,R334,R335	8	S19400-2210	221 1/4W
TP2,TP3,TP4,TP5	4	T13640-11	45J
X1	1	S17900-1	QUAD 2-INPUT NAND (SS)
X2	1	M15102-3	UNDERVOLT. SENSING CIR. (SS)
X3,X5	2	S17900-13	QUAD TWO INPUT AND GATE (SS)
X10	1	M15101-6	MPU (SS)
X11,X12	2	S19650-7	IC,CMOS,TRNSCVR,BUS (SS)
X13	1	s21291-5	ROM ASSEMBLY (SS)
X14,X37	2	M15105-4	IC,CMOS,CONVERTER,A/D (SS)
X15	1	M15104-6	MPU (SS)
X16,X20,X55	3	S17900-25	IC,CMOS,LATCH,3-STATE (SS)
X21	1	S19650-1	HEX INVERTER (SS)
X24	1	M14428-2	CRYSTAL,(MODULE),25.0MHZ
X25	1	S21292-5	IC,CMOS,MCU,DSP (SS)
X26	1	S15128-4	LM224 OP-AMP
X27,X28,X29,X30,X68,X90	6	S19650-5	IC,CMOS,LATCH,3-STATE (SS)
X38	1	S21293-3	DSP ASSEMBLY (SS)
X39	1	S21294-1	IC,CMOS,PLD,GENERIC (SS)
X41	1	S17900-24	QUAD SCHMITT NAND (SS)
X42,X43	2	S19650-3	1-OF-4 DECO/DEMUX (SS)
X44	1	S19650-6	IC,CMOS,MUX,4-INPUT (SS)
X45,X46	2	M15104-11	IC,CMOS,EEPROM,FLASH (SS)
X54	1	M15105-11	CONVERTER,D/A (SS)
X56	1	M14513-4	IC,CONVERTER,D/A (SS)
X61,X71,X92	3	S15128-18	QUAD-OP AMP
X63,X64	2	S17900-22	QUAD ANALOG SWITCH (SS)
X91	1	S15128-10	VOLTAGE REF.
X93	1	S15128-21	IC,COMPARATOR,HI-SPD,5-V
Y2	1	S16665-5	8.0 MHZ

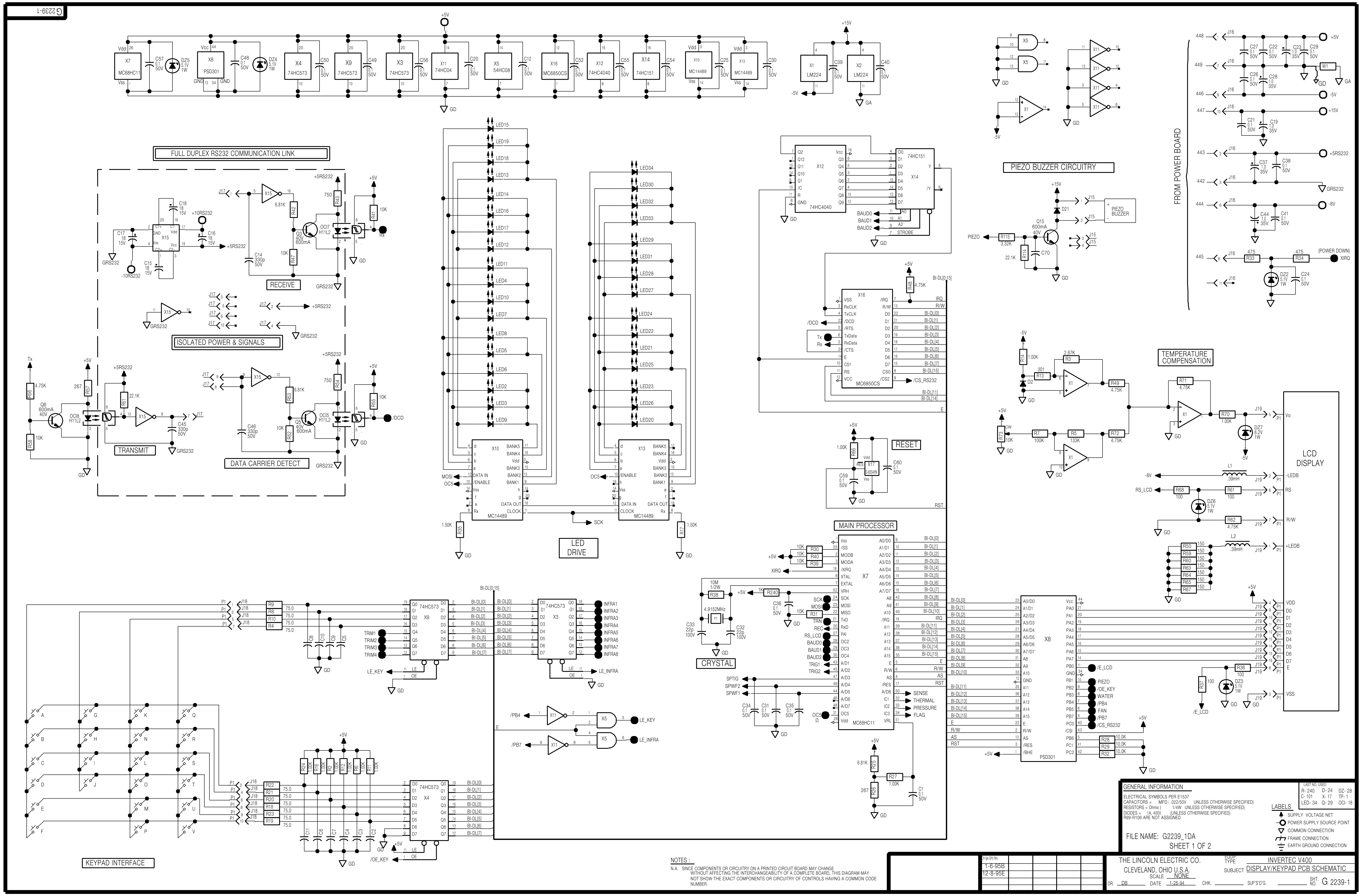
CAPACITORS = MFD/VOLTS
INDUCTANCE = HENRIES
RESISTANCE = OHMS

ITEM	REQ'D	PART NO.	DESCRIPTION
C1,C2,C6,C8,C11,C16,C17 C18,C19,C20,C21,C22,C23 C24,C27,C28,C29,C31,C32 C34,C37,C40,C41,C42,C43 C44,C45,C48,C59,C60,C61 C62,C63,C64,C65,C66,C67 C68,C69,C73,C77,C79,C81 C83,C84,C95,C97,C98,C100 C105,C111,C119,C155,C156	54	S16668-11	.1/50
C3,C25,C26	3	S16668-2	47pF/100
C4,C5,C49,C50,C51,C57,C85	7	S16668-1	22pF/100
C7,C47,C70,C130	4	S13490-42	1.0/35
C10,C13,C15	3	S13490-25	4.7/35
C30,C56,C90,C126,C135	5	S16668-8	330pF/100
C33,C35,C38,C39	4	S13490-39	18/15
C52,C53,C54,C106,C108,C114 C120,C134,C137,C138,C139 C140	12	S16668-7	820pF/50
C87,C91,C96,C101,C132,C133 C141,C142,C144,C145,C148 C150,C151,C152,C153	15	S16668-5	.022/50
C88	1	S13490-85	.27/50
C107,C110,C112,C115,C116 C117,C123,C127,C128,C136	10	S16668-9	150pF/100
C109,C113,C121,C124	4	S16668-4	2700pF/50
C118,C122,C125,C129	4	S13490-3	.0047/400
C143,C146	2	S16668-6	4700pF/50
D2,D17,D18,D19,D20,D21,D22 D25,D26,D27,D28,D29,D30 D31,D32,D33,D34,D35,D36 D37,D38,D39,D40,D41,D42 D43,D46	27	T12199-1	1N4004
D4,D5,D10,D11,D12,D13,D14 D15,D16,D24,D47	11	T12705-22	1N914
D23,D50,D51,D52	4	T12705-34	1N4936
DZ2,DZ5	2	T12702-40	1N4735
DZ3,DZ4	2	T12702-45	1N4746A
DZ6,DZ27,DZ34,DZ35	4	T12702-29	1N4744A
DZ7,DZ8,DZ9,DZ10,DZ11,DZ12 DZ13,DZ14,DZ15,DZ16,DZ17 DZ18,DZ19,DZ20,DZ21,DZ22 DZ30,DZ31,DZ32,DZ33	20	T12702-52	1N4733A
J20,J21	2	S20351-8	HEADER
J22	1	S20351-12	HEADER
J23,J26	2	S20351-6	HEADER
J24	1	S20351-14	HEADER
J25	1	S20351-10	RT. ANGLE HEADER
J27,J28	2	S20351-4	HEADER
OCI2,OCI3,OCI4,OCI7,OCI8	5	S15000-10	OPTO ISOLATOR
OCI5,OCI6	2	S15000-23	6N136 OPTOCOUPLER
Q2,Q3,Q4,Q5,Q6,Q7,Q8,Q9 Q10,Q13,Q16,Q19,Q20,Q23 Q28,Q33,Q34	17	T12704-68	2N4401
Q12	1	T12704-73	IC PKG MOSFET (SS)
Q14,Q15,Q22,Q27,Q31,Q32	6	T12704-69	2N4403
Q17,Q18,Q21,Q25	4	T12704-35	NPN TRANSISTOR
Q24,Q26,Q29,Q30	4	T12704-47	.5AMP / 300 VOLT PNP
R2,R4,R8,R9,R10,R12,R13 R14,R16,R18,R20,R32,R35 R41,R58,R59,R60,R61,R62 R63,R65,R72,R74,R158,R169 R170,R172,R185,R193,R198 R202,R210,R213,R222,R235 R239,R246,R251,R255,R257 R262,R264,R267,R268,R279 R284,R295,R296,R297,R317 R318,R319	52	S19400-1002	10K 1/4W
R3,R7,R68,R70,R142,R154 R161,R214,R216,R302,R310 R314,R336,R337,R338,R339 R341,R342,R343,R344,R345	21	S19400-4751	4.75K
R5,R37,R87,R293,R294	5	S19400-2211	2.21K 1/4W
R6	1	T14231-2	10M 1/2W
R11,R99,R141,R148,R175 R209,R223,R263,R266,R277	10	S19400-1003	100K 1/4W
R15,R36,R38,R39,R40,R64 R67,R69,R71,R73,R89,R90 R91,R92,R93,R94,R97,R108 R110,R118,R120,R127,R135 R152,R156,R168,R171,R173 R179,R180,R183,R186,R187 R188,R189,R191,R192,R199 R203,R221,R228,R231,R258 R275,R280,R300,R301,R308 R311,R315	50	S19400-1001	1K 1/4W
R17,R19,R109	3	S19400-1502	15K 1/4W
R21,R23,R24,R182,R227,R232 R242,R244	8	S19400-26R7	26.7 1/4W
R22,R29,R274	3	S19400-2670	267 1/4W
R25,R28,R270,R271	4	S19400-1000	100 1/4W
R26,R27,R30,R31,R34,R42 R43,R44,R45,R46,R47,R48 R49,R50,R51,R52,R53,R54 R55,R56,R57,R122,R128,R146 R147,R167,R177,R184	28	S19400-4750	475 1/4W
R33,R86,R229,R230	4	S19400-2672	26.7K 1/4W
R66,R84	2	S19400-4752	47.5K 1/4W
R96,R98	2	S19400-1501	1.5K 1/4W
R119,R126,R134,R138,R226 R259,R327	7	S19400-6810	681 1/4W
R121,R129,R130,R174,R181 R278	6	S19400-3322	33.2K 1/4W
R149,R194,R196,R218,R233	5	S19400-7500	750 1/4W

11-12-99C G2861-2

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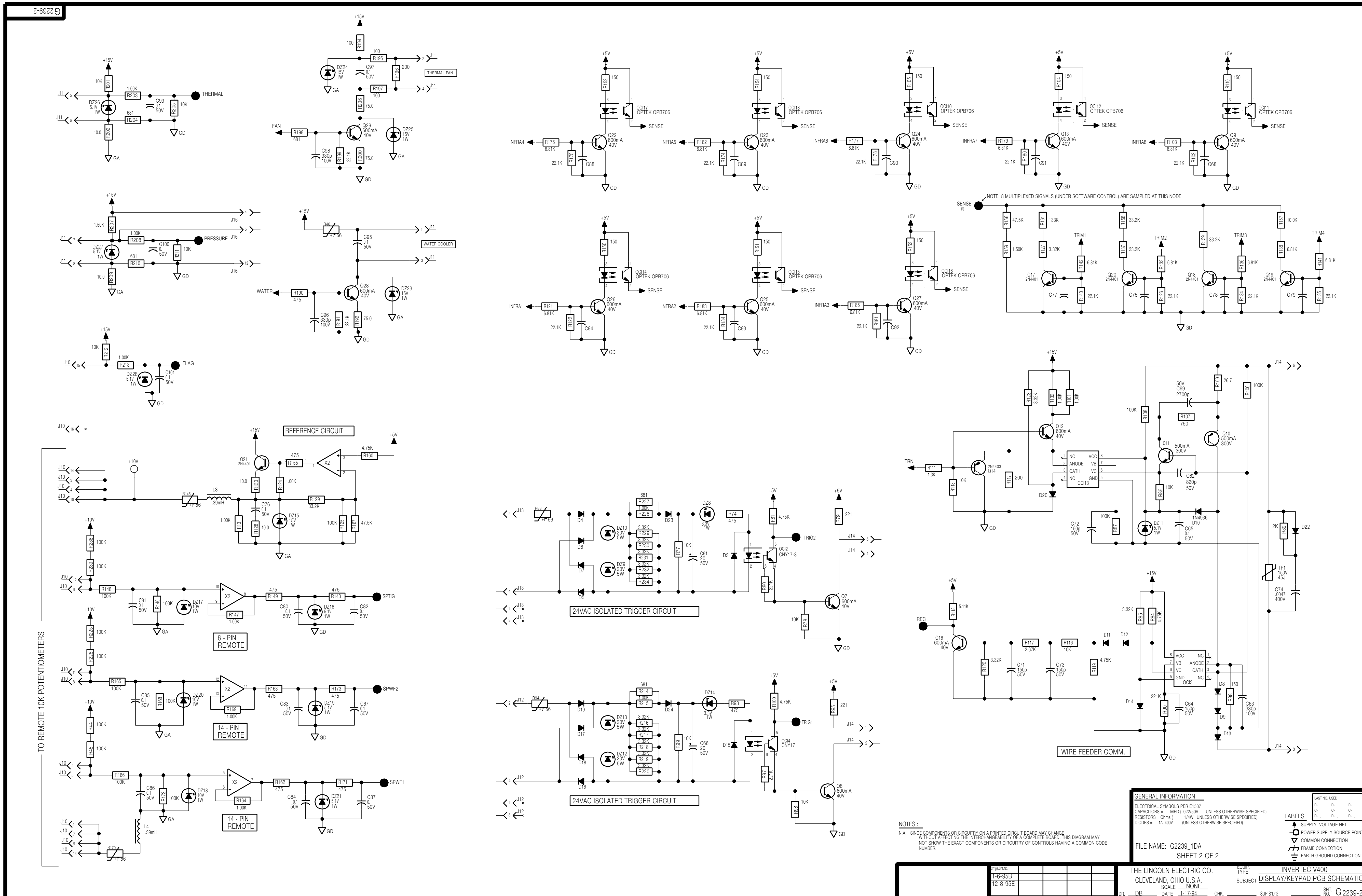
SCHEMATIC - DISPLAY PC BOARD (SHEET 1)



NOTE: This diagram is for reference only. It may not be accurate for all machines covered by this manual.

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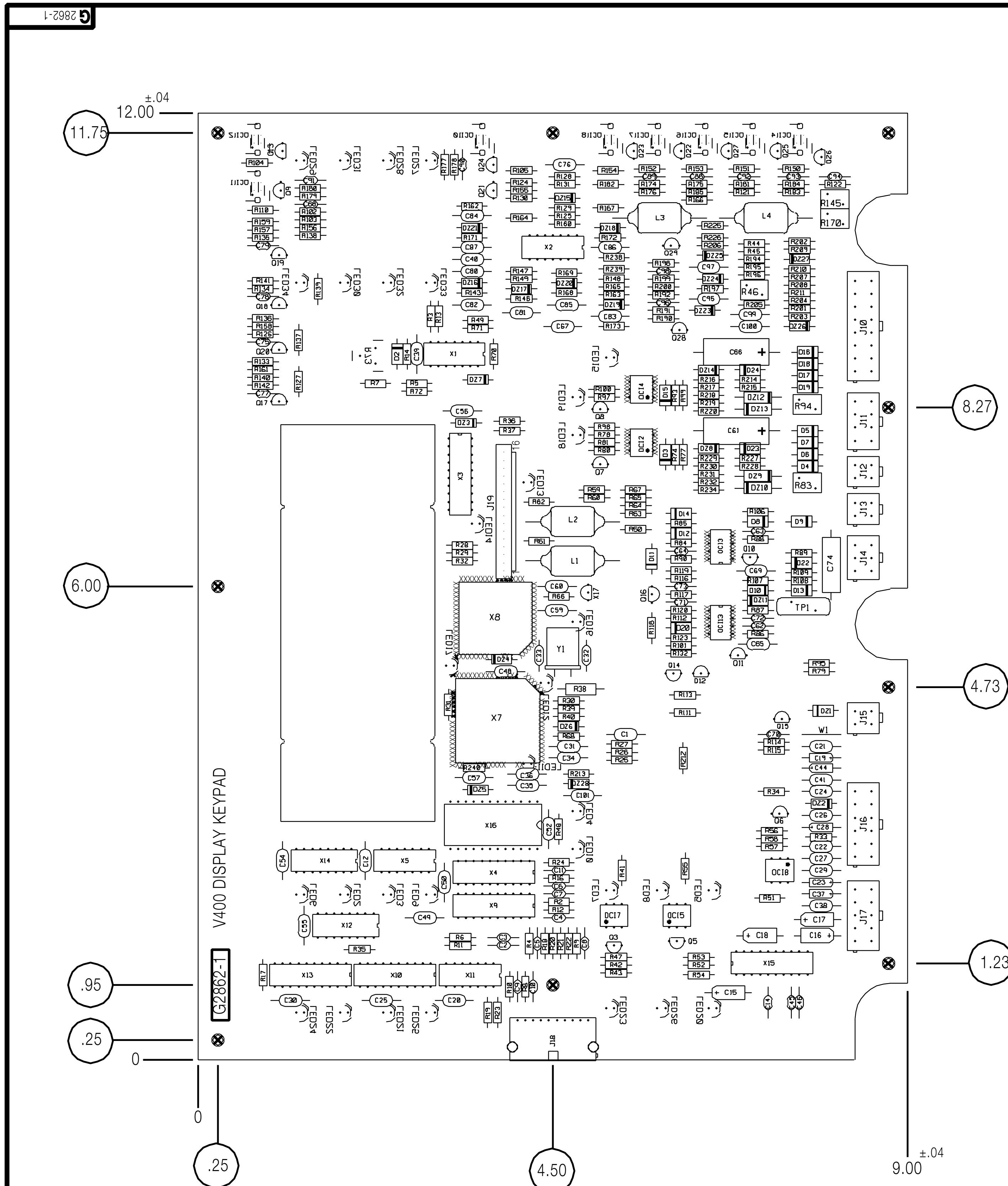
SCHEMATIC - DISPLAY PC BOARD (SHEET 2)



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Return to Section TOC
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Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC

PC BOARD ASSEMBLY-DISPLAY



ITEM	REQ'D	PART NO.	DESCRIPTION
R50,R59,R60,R63,R64,R65 R67,R88,R104,R105,R110 R150,R151,R152,R153,R154	16	S19400-1500	150 1/4W
R51,R102,R114,R122,R126 R134,R135,R140,R174 R175,R178,R180,R181 R184,R191,R199	16	S19400-2212	22.1K 1/4W
R73	1	T10812-41	10K 1/2W TRIMMER
R79,R95	2	S19400-2210	221 1/4W
R80,R90,R97	3	S19400-2213	221K 1/4W
R85,R115,R120,R123,R127,R216 R217,R218,R219,R220,R229 R230,R231,R232,R234	15	S19400-3321	3.32K 1/4W
R89	1	S19400-2001	2.0K 1/4W
R109	1	S19400-26R7	26.7 1/4W
R111	1	S19400-1301	1.3K 1/4W
R112,R196	2	S19400-2000	200 1/4W
R118	1	S19400-5111	5.11K 1/4W
R128,R130,R202,R209	4	S19400-10R0	10 1/4W
R129,R137,R139,R158	4	S19400-3322	33.2K 1/4W
R156,R167	2	S19400-4752	47.5K 1/4W
R198,R204,R210,R214,R227	5	S19400-6810	681 1/4W
TP1	1	T13640-11	45J
W1	1	CJ000001	E2387-#20-2.00 (JUMPER)
X1,X2	2	S15128-4	LM224 OP-AMP
X3,X4,X9	3	S17900-25	IC,CMOS,LATCH,3-STATE (SS)
X5	1	S17900-13	QUAD TWO INPUT AND GATE (SS)
X7	1	S23996	HC11 MICROPROCESSOR(SS)
X8	1	S21290-4	ROM ASSEMBLY(SS)
X10,X13	2	S20496-1	LED DRIVER (SS)
X11	1	S17900-2	HEX INVERTER (SS)
X12	1	S17900-6	12 STAGE BINARY COUNTER (SS)
X14	1	S17900-26	SELECT/MULTIPLX(SS)
X15	1	S20353-1	IC,CMOS,DRVR/RCVR,EIA232
X16	1	S20603-1	IC,CMOS,ACIA,2.0MHZ,68B50P
X17	1	M15102-3	RESET I.C. UNDERVOLT. SENSING CIR. (SS)
Y1	1	S16665-6	CRYSTAL,QUARTZ,4.9152MHZ

CAPACITORS = MFD/VOLTS
INDUCTANCE = HENRIES
RESISTANCE = OHMS

ITEM	REQ'D	PART NO.	DESCRIPTION
C1,C12,C20,C21,C22,C24,C25 C26,C27,C29,C30,C31,C34 C35,C36,C38,C39,C40,C41 C48,C49,C50,C52,C54,C55 C56,C57,C59,C60,C65,C67 C76,C80,C81,C82,C83,C84 C85,C86,C87,C95,C97,C99 C100,C101	45	S16668-11	.1/50
C2,C3,C4,C5,C6,C7,C8,C9 C10,C11,C68,C70,C75,C77 C78,C79,C88,C89,C90,C91 C92,C93,C94	23	S16668-5	.022/50
C14,C45,C46,C63,C96,C98	6	S16668-8	330pF/100
C15,C16,C17,C18	4	S13490-39	18/15
C100,C101			
C32,C33	2	S16668-1	22pF/100
C61,C66	2	S13490-73	20/50
C62	1	S16668-7	820pF/50
C64,C71,C72,C73	4	S16668-9	150pF/100
C69	1	S16668-4	2700pF/50
C74	1	S13490-3	.0047/400
D2,D3,D4,D5,D6,D7,D8,D9 D11,D12,D13,D14,D15,D16 D17,D18,D19,D20,D21,D22 D23,D24	22	T12199-1	1N4004
D10	1	T12705-34	1N4936
DZ2,DZ3,DZ4,DZ5,DZ6,DZ11 DZ16,DZ19,DZ21,DZ26,DZ27 DZ28	12	T12702-52	1N4733
DZ7	1	T12702-55	1N4738A
DZ8,DZ14	2	T12702-53	1N4728A
DZ9,DZ10,DZ12,DZ13	4	T12702-25	1N5357B
DZ15,DZ23,DZ24,DZ25	4	T12702-29	1N4744A
DZ17,DZ18,DZ20	3	T12702-27	1N4740
J10	1	S18248-16	HEADER
J11	1	S18248-8	CONNECTOR
J12,J13,J15	3	S18248-4	HEADER
J14	1	S18248-6	HEADER
J16	1	S18248-12	HEADER
J17	1	S18248-10	HEADER
J18	1	S19365-10	RT. ANGLE HEADER
J19	1	S18899-16	ST. HEADER
L1,L2,L3,L4	4	T12218-9	.39mH
LED2,LED3,LED4,LED5,LED6 LED7,LED8,LED9,LED10,LED11 LED12,LED13,LED14,LED15 LED16,LED17,LED18,LED19 LED20,LED21,LED22,LED23 LED25,LED26,LED27,LED28 LED29,LED30,LED31,LED32 LED33,LED34	32	T13657-3	GREEN LED
LED24	1	T13657-4	YELLOW LED
OCI2,OCI4	2	S15000-10	OPTO ISOLATOR
OCI3,OCI13	2	S15000-23	6N136 OPTOCOUPLER
OCI5,OCI7,OCI8	3	S15000-19	IC,OPTOISOLATER
OCI10,OCI11,OCI12,OCI14 OCI15,OCI16,OCI17,OCI18	8	S15000-24	OPTOSENSOR,REFLECTIVE
Q3,Q5,Q6,Q7,Q8,Q9,Q12,Q13 Q15,Q16,Q17,Q18,Q19,Q20 Q21,Q22,Q23,Q24,Q25,Q26 Q27,Q28,Q29	23	T12704-68	2N4401
Q10	1	T12704-47	.5AMP/300V PNP
Q11	1	T12704-35	NPN TRANSISTOR
Q14	1	T12704-69	2N4403
R2,R6,R11,R12,R14,R16,R24 R27,R66,R70,R101,R124,R131 R132,R147,R164,R169,R203 R208,R213,R215,R228,R240	23	S19400-1001	1K 1/4W
R3,R117	2	S19400-2671	2.67K 1/4W
R4,R8,R9,R10,R18,R19,R20 R197	13	S19400-75R0	75 1/4W
R5,R161	2	S19400-1333	133K 1/4W
R7,R44,R45,R87,R106,R108 R125,R146,R148,R165,R166 R168,R172,R225,R226,R238 R239	17	S19400-1003	100K 1/4W
R13	1	S19400-3010	301 1/4W
R17,R35,R159,R207	4	S19400-1501	1.5K 1/4W
R25,R42,R53,R103,R121,R133 R136,R138,R141,R142,R176 R177,R179,R182,R183,R185	16	S19400-6811	6.81K 1/4W
R26,R57	2	S19400-2670	267 1/4W
R28,R29,R30,R31,R32,R39 R40,R41,R47,R52,R55,R58,R77 R78,R86,R98,R99,R113,R116 R157,R201,R205,R211,R212	24	S19400-1002	10K 1/4W
R33,R34,R74,R93,R143,R149 R155,R162,R163,R171,R173 R190	12	S19400-4750	475 1/4W
R36,R37,R61,R68,R194,R195 R197	7	S19400-1000	100 1/4W
R38	1	T14231-2	10M 1/2W
R43,R54,R107	3	S19400-7500	750 1/4W
R46,R83,R94,R145,R170	5	S18380-1	PTC THERMISTOR
R48,R49,R56,R62,R71,R72 R81,R84,R100,R119,R160	11	S19400-4751	4.75K

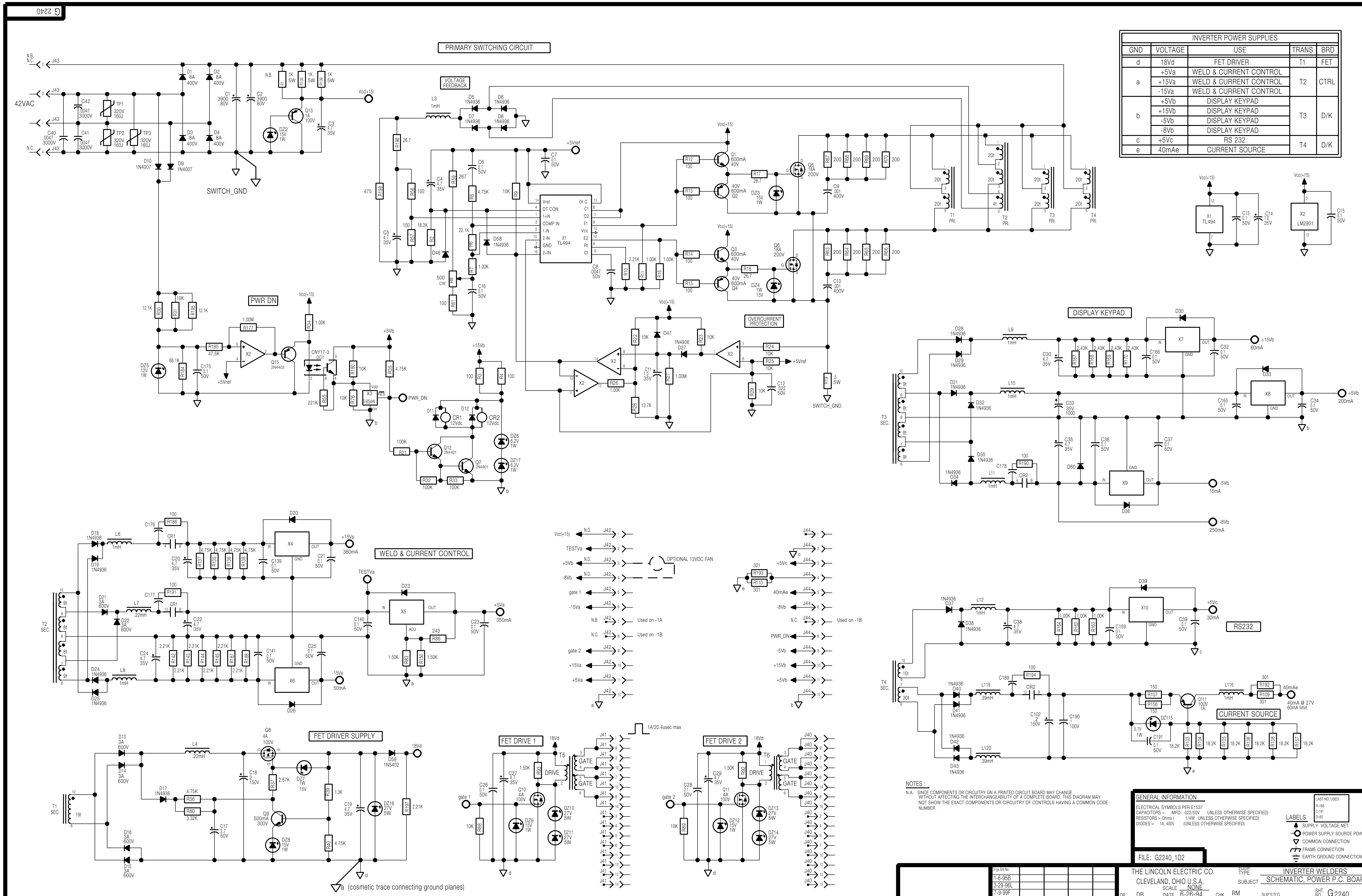
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2-10-95F	1-7-2000E
8-11-95C	
12-8-95E	
1-26-96	

THE LINCOLN ELECTRIC CO. CLEVELAND, OHIO U.S.A.
EQUIP. TYPE INVERTER WELDERS
SUBJECT DISPLAY/KEYPAD P.C. BOARD ASSEMBLY
SCALE FULL
DR MP DATE 9-22-94 CHK DRS REF. G2407-1 SUP'S'D'G
SHT. NO. G 2862-1

NOTE: Lincoln Electric assumes no responsibility for liablilities resulting from board level troubleshooting. PC Board repairs will invalidate your factory warranty. **Individual Printed Circuit Board Components are not available from Lincoln Electric.** This information is provided for reference only. Lincoln Electric discourages board level troubleshooting and repair since it may compromise the quality of the design and may result in danger to the Machine Operator or Technician. Improper PC board repairs could result in damage to the machine.

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SCHEMATIC - POWER PRINTED CIRCUIT BOARD

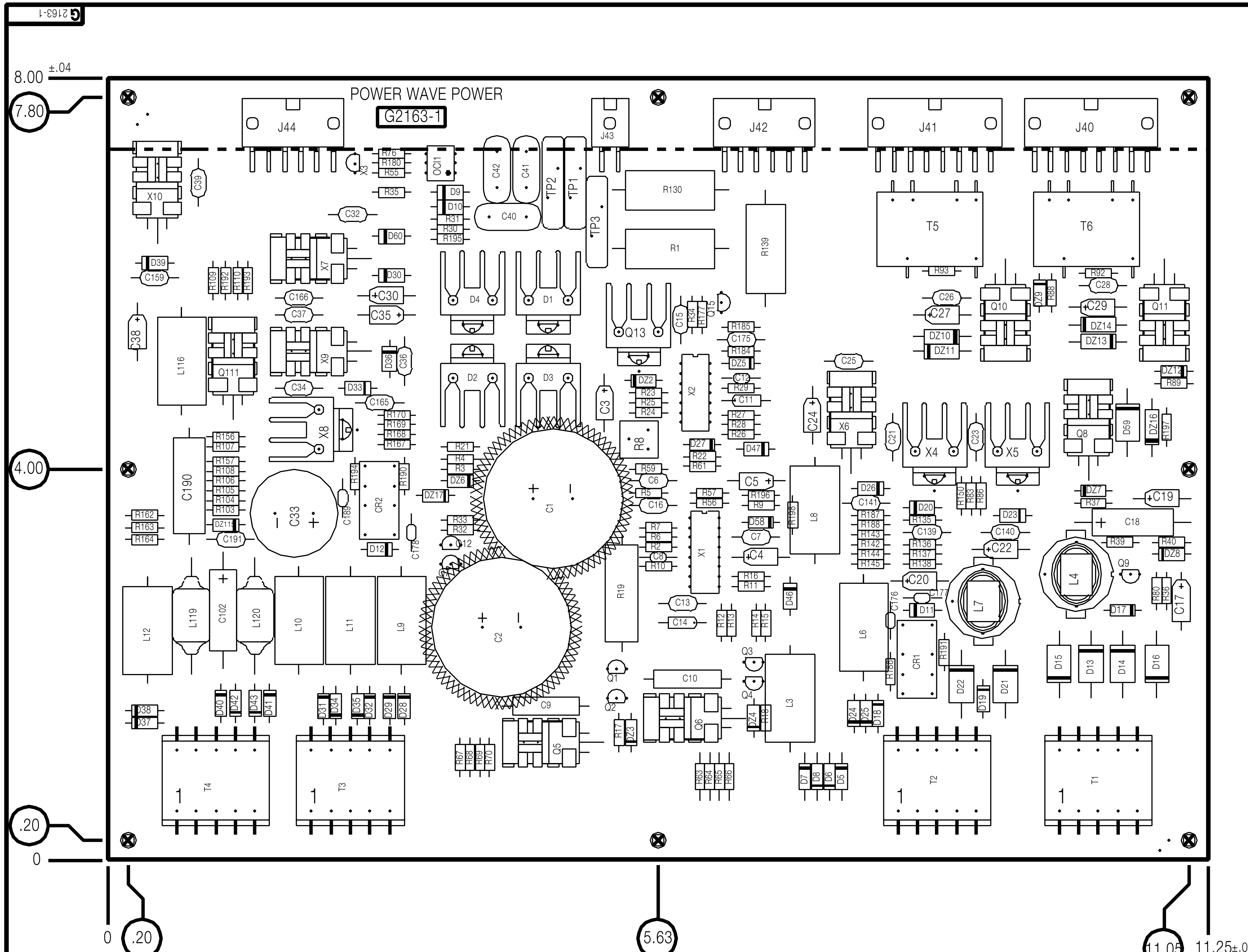


GND	VOLTAGE	USE	TRANS	BRD
d	18Vd	FET DRIVER	T1	FET
a	+5Va	WELD & CURRENT CONTROL	T2	CTRL
	+15Va	WELD & CURRENT CONTROL		
	-15Va	WELD & CURRENT CONTROL		
b	+5Vb	DISPLAY KEYPAD	T3	D/K
	+15Vb	DISPLAY KEYPAD		
	-5Vb	DISPLAY KEYPAD		
	-8Vb	DISPLAY KEYPAD		
c	+5Vc	RS 232	T4	D/K
e	40mAe	CURRENT SOURCE		

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PC BOARD ASSEMBLY-POWER



ITEM	REQ'D	PART NO.	DESCRIPTION
C1,C2	2	S13490-141	3900/80V
C3,C4,C5,C19,C20,C22,C24 C27,C29,C30,C35,C38	12	S13490-25	4.7/35
C6,C7,C13,C15,C16,C21,C23 C25,C26,C28,C32,C34,C36 C37,C39,C139,C140,C141 C159,C165,C166,C175,C191	23	S16668-11	1/50
C8	1	S16668-6	4700pF/50
C9,C10	2	S13490-76	.001/400
C11,C14	2	S13490-42	1.0/35
C12,C176,C177,C178,C189	5	S16668-5	.022/50
C17	1	S13490-40	2.7/50
C18,C102	2	S13490-68	2/150
C33	1	S13490-121	
C40,C41,C42	3	T11577-58	.0047/3000V
C190	1	T11577-26	.1/100
CR1,CR2	2	S13929-8	RELAY, 12V DC
D1,D2,D3,D4	4	S18395-22	DIODE HS ASBLY
D5,D6,D7,D8,D17,D18,D19 D24,D25,D27,D28,D29,D31 D32,D34,D35,D37,D38,D40 D41,D42,D43,D58	23	T12705-34	1N4936
D9,D10	2	T12199-2	1N4007
D11,D12,D20,D23,D26,D30 D33,D36,D39,D46,D47,D60	12	T12199-1	1N4004
D13,D14,D15,D16,D21,D22	6	T12705-59	600V/3A
D59	1	T12705-14	DIODE
DZ2,DZ3,DZ4,DZ7,DZ8,DZ9 DZ12	7	T12702-29	1N4744A
DZ5	1	T12702-19	1N4742A
DZ6,DZ17	2	T12702-40	1N4735
DZ10,DZ11,DZ13,DZ14,DZ16	5	T12702-17	1N5361B ZENER DIODE
DZ115	1	T12702-52	1N4733A
J40,J41	2	S20351-16	HEADER
J42,J44	2	S20351-12	HEADER
J43	1	S20351-4	HEADER
L3,L6,L8,L9,L10,L11,L12,L116	8	T12218-12	CHOKE
L4,L7	2	T12218-11	INDUCTOR
L119,L120	2	T12218-9	.39mH
OCI1	1	S15000-10	OPTO ISOLATOR
Q1,Q3,Q7,Q12	4	T12704-68	2N4401
Q2,Q4,Q15	3	T12704-69	2N4403
Q5,Q6	2	T12704-61	TRANSISTOR (SS)
Q9	1	T12704-35	NPN TRANSISTOR
Q8,Q10,Q11	3	T12704-80	TRANSISTOR-NMF
Q13	1	S18395-19	PNP TRANSISTOR H.S. ASBLY
Q111	1	T12704-37	TRANSISTOR-P
R1,R130,R139	3	T14648-19	1K 5W
R2,R103,R104,R105,R106, R108,R157	7	S19400-1822	8.2K 1/4W
R3,R4,R12,R13,R14,R15,R56 R57,R61,R186,R190,R191,R194	13	S19400-1000	100 1/4W
R5,R35,R36,R40,R135,R136 R137,R138	8	S19400-4751	4.75K
R6	1	S19400-2212	22.1K 1/4W
R7,R11,R16,R26,R34,R162 R163,R164	8	S19400-1001	1K 1/4W
R8	1	T10812-62	500 1/2W TRIMMER
R9,R22,R23,R24,R25,R29,R31 R76,R88,R89,R180	11	S19400-1002	10K 1/4W
R10,R142,R143,R144,R145 R187,R188,R197	8	S19400-2211	2.21K 1/4W
R17,R18,R196	3	S19400-26R7	26.7 1/4W
R19	1	T12300-80	5 WATT 0.5 OHM RESISTOR
R21,R32,R33	3	S19400-1003	100K 1/4W
R27,R177	2	S19400-1004	1M 1/4W
R28	1	S19400-1372	13.7K 1/4W
R30,R195	2	S19400-1212	12.1K 1/4W
R37	1	S19400-2671	2.67K 1/4W
R39	1	S19400-1301	1.3K 1/4W
R55	1	S19400-2213	221K 1/4W
R59	1	S19400-2670	267 1/4W
R63,R64,R65,R66,R67,R68 R69,R70	8	S19400-2000	200 1/4W
R80	1	S19400-3321	3.32K 1/4W
R83,R92,R93,R150	4	S19400-1501	1.5K 1/4W
R86	1	S19400-2430	243 1/4W
R107,R156	2	S19400-1500	150 1/4W
R109,R110,R192,R193	4	S19400-3010	301 1/4W
R167,R168,R169,R170	4	S19400-2431	2.43K 1/4W
R184	1	S19400-6812	68.1K 1/4W
R185	1	S19400-4752	47.5K 1/4W
R198	1	S19400-4750	475 1/4W
T1	1	M16744-1	TRANSFORMER
T2	1	M16744-4	TRANSFORMER
T3	1	M16744-3	TRANSFORMER
T4	1	M16744-2	TRANSFORMER
T5,T6	2	T12737-7	PULSE TRANSFORMER
TP1,TP2,TP3	3	T13640-18	160J
X1	1	M15458-3	PWM CONTROLLER,IC
X2	1	S15128-11	14 PIN QUAD COMPARATOR
X3	1	M15102-3	RESET I.C. UNDERVOLT. SENSING CIR. (SS)
X4	1	S18395-8	REGULATOR ASSEMBLY
X5	1	S18395-7	S15128-15 ON S18104-5
X6	1	S15128-12	IC - VOLT REG
X7	1	S15128-6	IC - VOLT REG
X8	1	S18395-13	5V REG. ASBLY
X9	1	S15128-7	IC - VOLT REG
X10	1	S15128-5	IC - VOLT REG

CAPACITORS = MFD/VOLTS
RESISTORS = OHMS

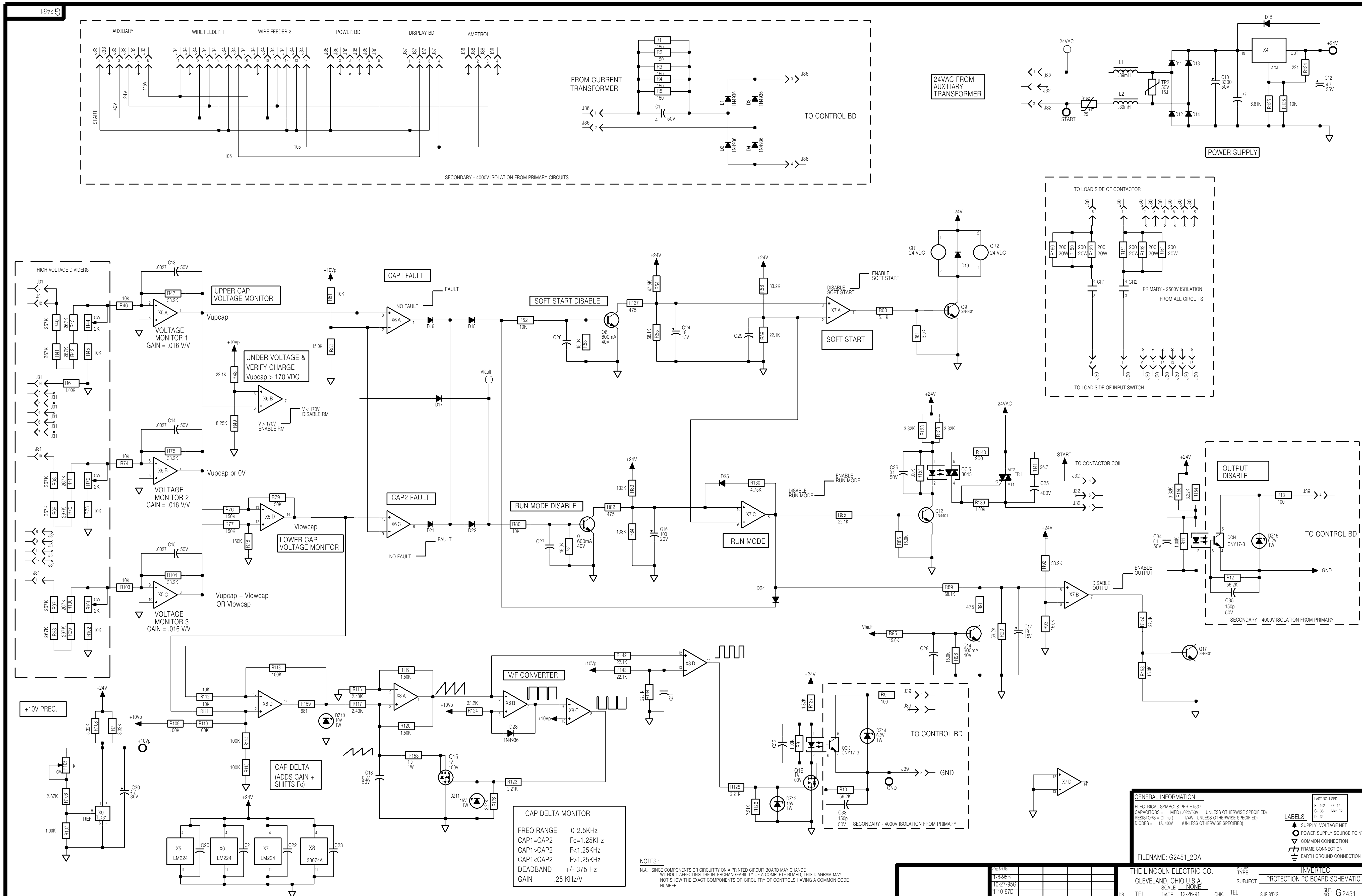
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THE LINCOLN ELECTRIC CO. CLEVELAND, OHIO U.S.A.
EQUIP. TYPE: INVERTER WELDERS
SUBJECT: POWER P.C. BOARD ASSEMBLY
SCALE: FULL
DR: FM DATE: 3-9-94 CHK: DB/FV REF. SUP'S'D'G
SHT. NO. G 2163-1

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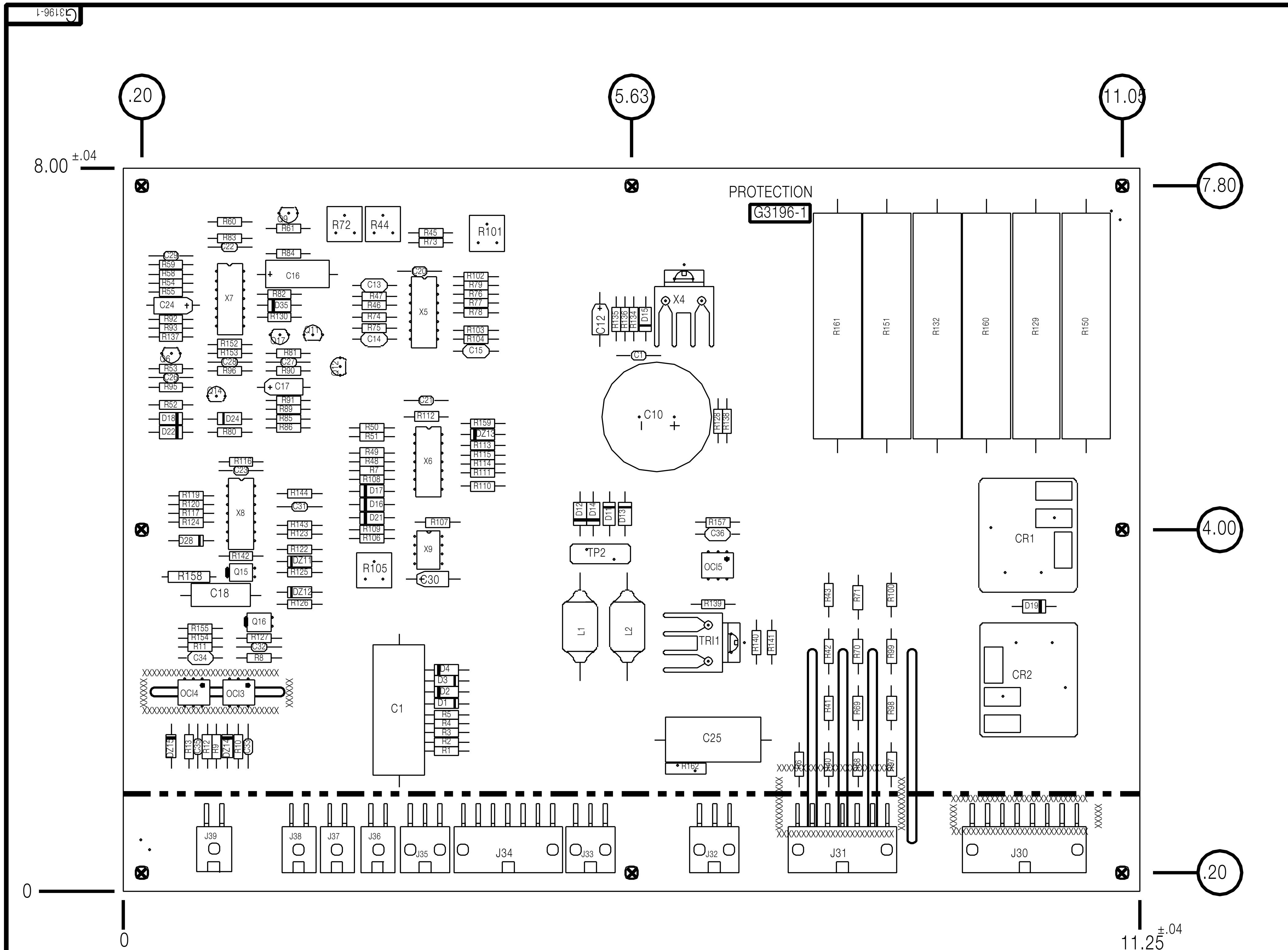
SCHEMATIC - PROTECTION PRINTED CIRCUIT BOARD



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PC BOARD ASSEMBLY-PROTECTION



ITEM	REQ'D	PART NO.	IDENTIFICATION
C1	1	T11577-50	4.0MFD,50V CAPACITOR
C10	1	S13490-92	3300 / 50
C11,C20,C21,C22,C23,C26 C27,C28,C29,C31,C32	11	S16668-5	.022/50
C12,C30	2	S13490-25	4.7/35
C13,C14,C15	3	S16668-4	2700pF/50
C16	1	S13490-97	100 / 20
C17,C24	2	S13490-39	18 / 15
C18	1	S13490-85	.27/50
C25	1	T11577-57	0.1/400
C33,C35	2	S16668-9	150pF/100
C34,C36	2	S16668-11	.1/50
CR1,CR2	2	S15122-4	RELAY
D1,D2,D3,D4,D28	5	T12705-34	1N4936
D11,D12,D13,D14,D15,D16 D17,D18,D19,D21,D22,D24 D35	13	T12199-1	1N4004
DZ11,DZ12	2	T12702-29	1N4744A
DZ13	1	T12702-27	1N4740
DZ14,DZ15	2	T12702-40	1N4735
J30	1	S20351-16	HEADER
J31,J34	2	S20351-14	HEADER
J32,J33,J35	3	S20351-6	HEADER
J36,J37,J38,J39	4	S20351-4	HEADER
L1,L2	2	T12218-9	39mH
OCI3,OCI4	2	S15000-10	OPTO ISOLATOR
OCI5	1	S15000-11	3043
Q6,Q9,Q11,Q12,Q14,Q17	6	T12704-68	2N4401
Q15,Q16	2	T12704-73	IC PKG MOSFET (SS)
R1,R2,R3,R4,R5	5	S19400-1500	150 1/4W
R6,R8,R11,R107,R139,R157	6	S19400-1001	1K 1/4W
R7,R108,R128,R138,R154 R155	6	S19400-3321	3.32K 1/4W
R9,R13	2	S19400-1000	100 1/4W
R10,R12,R90	3	S19400-5622	56.2K 1/4W
R40,R41,R42,R43,R68,R69 R70,R71,R97,R98,R99,R100	12	S19400-2673	267K 1/4W
R44,R72,R101	3	T10812-73	2K 1/2W TRIMMER
R45,R73,R102	3	S19400-5621	5.62K 1/4W
R46,R51,R52,R74,R80,R103 R111,R112,R136	9	S19400-1002	10K 1/4W
R47,R58,R75,R92,R104,R124	6	S19400-3322	33.2K 1/4W
R48,R59,R85,R142,R143,R144 R152	7	S19400-2212	22.1K 1/4W
R49	1	S19400-8251	8.25K 1/4W
R50,R53,R61,R81,R86,R93 R95,R96,R153	9	S19400-1502	15K 1/4W
R54	1	S19400-4752	47.5K 1/4W
R55,R89	2	S19400-6812	68.1K 1/4W
R60	1	S19400-5111	5.11K 1/4W
R76,R77,R78,R79	4	S19400-1503	150K 1/4W
R82,R91,R137	3	S19400-4750	475 1/4W
R83,R84	2	S19400-1333	133K 1/4W
R105	1	T10812-68	1K 1/2W TRIMMER
R106	1	S19400-2671	2.67K 1/4W
R109,R110,R113,R114,R115	5	S19400-1003	100K 1/4W
R116,R117	2	S19400-2431	2.43K 1/4W
R119,R120	2	S19400-1501	1.5K 1/4W
R122,R123,R125,R126	4	S19400-2211	2.21K 1/4W
R127	1	S19400-1821	1.82K 1/4W
R129,R132,R150,R151,R160 R161	6	T14900-1	200 20W
R130	1	S19400-4751	4.75K
R134	1	S19400-2210	221 1/4W
R135	1	S19400-6811	6.81K 1/4W
R140	1	S19400-2000	200 1/4W
R141	1	S19400-26R7	26.7 1/4W
R158	1	T12300-79	1 WATT 1 OHM 1% RESISTOR
R159	1	S19400-6810	681 1/4W
R162	1	S18380-4	PTC THERMISTOR
TP2	1	T13640-15	15J
TRI1	1	S18395-9	S15161-27 ON S18104-5
X4	1	S18395-7	S15128-15 ON S18104-5
X5,X6,X7	3	S15128-4	LM224 OP-AMP
X8	1	S15128-18	QUAD-OP AMP
X9	1	S15128-10	VOLTAGE REF.

CAPACITORS = MFD/VOLTS
INDUCTANCE = HENRIES
RESISTORS = OHMS

THE LINCOLN ELECTRIC CO. CLEVELAND, OHIO U. S. A.
INVERTER WELDERS
PROTECTION P.C. BOARD ASSEMBLY
G3196-1

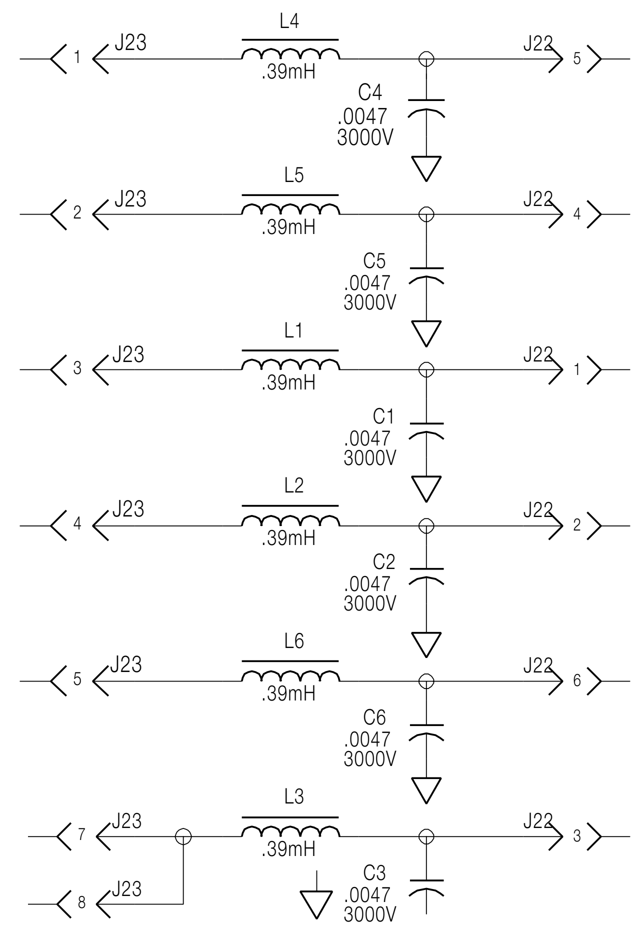
NOTE: Lincoln Electric assumes no responsibility for liablilities resulting from board level troubleshooting. PC Board repairs will invalidate your factory warranty. **Individual Printed Circuit Board Components are not available from Lincoln Electric.** This information is provided for reference only. Lincoln Electric discourages board level troubleshooting and repair since it may compromise the quality of the design and may result in danger to the Machine Operator or Technician. Improper PC board repairs could result in damage to the machine.

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Return to Master TOC

SCHEMATIC -SQUARE WAVE PROTECTION PRINTED CIRCUIT BOARD

M16115

AUSTRALIA CANADA FRANCE



NOTES :

N.A. SINCE COMPONENTS OR CIRCUITRY ON A PRINTED CIRCUIT BOARD MAY CHANGE WITHOUT AFFECTING THE INTERCHANGEABILITY OF A COMPLETE BOARD, THIS DIAGRAM MAY NOT SHOW THE EXACT COMPONENTS OR CIRCUITRY OF CONTROLS HAVING A COMMON CODE NUMBER.

GENERAL INFORMATION

ELECTRICAL SYMBOLS PER E1537
CAPACITORS = MFD (.022/50V UNLESS OTHERWISE SPECIFIED)
RESISTORS = Ohms (1/4W UNLESS OTHERWISE SPECIFIED)
DIODES = 1A, 400V (UNLESS OTHERWISE SPECIFIED)

LAST NO. USED
R- _
C- _
D- _

LABELS
SUPPLY VOLTAGE NET
POWER SUPPLY SOURCE POINT
COMMON CONNECTION
FRAME CONNECTION
EARTH GROUND CONNECTION

Ch'ge. Sht. No.
5-29-90SPA

THE LINCOLN ELECTRIC CO.
CLEVELAND, OHIO U.S.A.

EQUIP. TYPE SQUARE WAVE TIG 350
SUBJECT PROTECTION P.C. BOARD SCHEMATIC
SCALE NONE
DR MK/DRS DATE 1-12-90 CHK GM/BS REF. SUP'S'D'G
SHT. NO. M16115

NOTE: This diagram is for reference only. It may not be accurate for all machines covered by this manual.

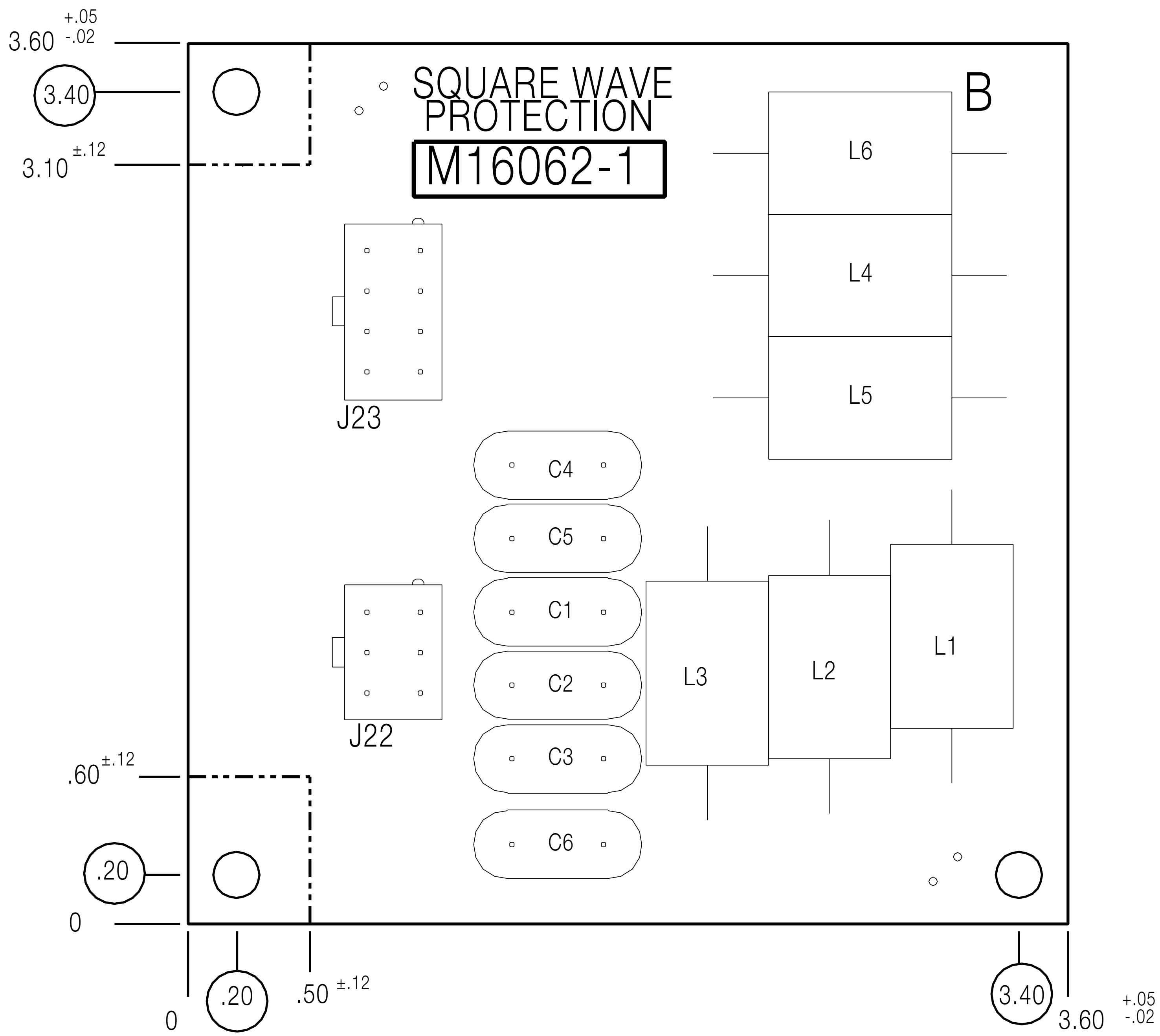
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PC BOARD ASSEMBLY-SQUARE WAVE PROTECTION

M16062-1

AICF	ITEM	REQ'D	PART NO.	IDENTIFICATION
	C1, C2, C3, C4, C5, C6	6	T11577-58	.0047/3000 V
	L1, L2, L3, L4, L5, L6	6	T12218-9F	.39 mH
	J22	1	S18248-6	HEADER
	J23	1	S18248-8	HEADER

CAPACITORS = MFD/VOLTS



Ch'ge. Sht. No.
12-8-89B
11-30-90B

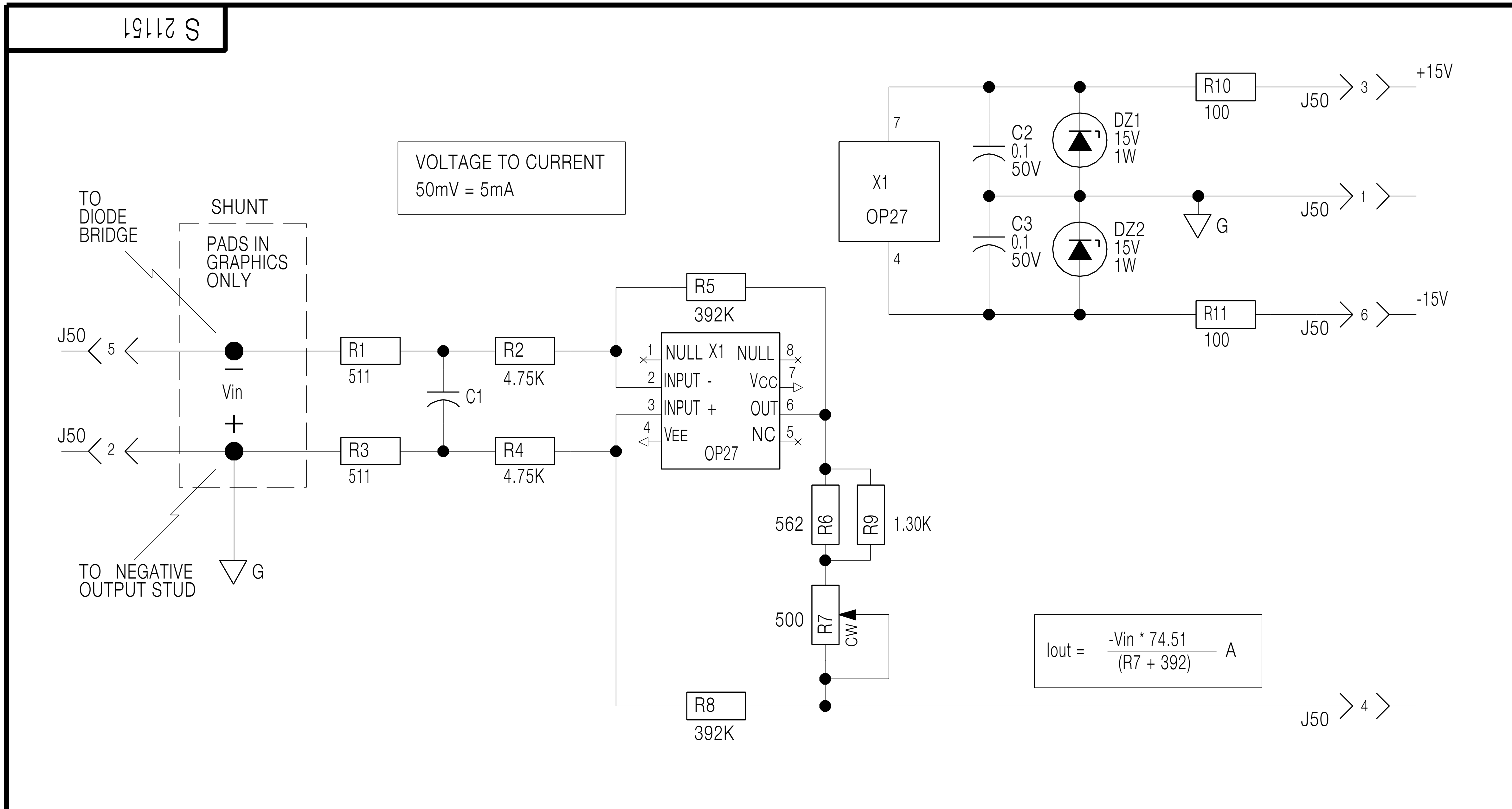
THE LINCOLN ELECTRIC CO.
CLEVELAND, OHIO U.S.A.

EQUIP. TYPE: SQUAREWAVE TIG 300 & 350
SUBJECT: PROTECTION P.C. BOARD ASSEMBLY
SCALE: DOUBLE
DR: FV DATE: 9-8-89 CHK: DEC REF.: L8088-1 SUP'S'D'G:
SHT. NO. M16062-1

NOTE: Lincoln Electric assumes no responsibility for liablilities resulting from board level troubleshooting. PC Board repairs will invalidate your factory warranty. **Individual Printed Circuit Board Components are not available from Lincoln Electric.** This information is provided for reference only. Lincoln Electric discourages board level troubleshooting and repair since it may compromise the quality of the design and may result in danger to the Machine Operator or Technician. Improper PC board repairs could result in damage to the machine.

Return to Section TOC
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SCHEMATIC - SHUNT PRINTED CIRCUIT BOARD



NOTES :

N.A. SINCE COMPONENTS OR CIRCUITRY ON A PRINTED CIRCUIT BOARD MAY CHANGE WITHOUT AFFECTING THE INTERCHANGEABILITY OF A COMPLETE BOARD. THIS DIAGRAM MAY NOT SHOW THE EXACT COMPONENTS OR CIRCUITRY OF CONTROLS HAVING A COMMON CODE NUMBER.

GENERAL INFORMATION

ELECTRICAL SYMBOLS PER E1537
CAPACITORS = MFD (.022/50V UNLESS OTHERWISE SPECIFIED)
RESISTORS = Ohms (1/4W UNLESS OTHERWISE SPECIFIED)
DIODES = 1A, 400V (UNLESS OTHERWISE SPECIFIED)

LABELS

SUPPLY VOLTAGE NET
POWER SUPPLY SOURCE POINT
COMMON CONNECTION
FRAME CONNECTION
EARTH GROUND CONNECTION

FILE: S21151_2BA

Ch'ge.Sht.No.			
1-6-95			
11-21-97G			

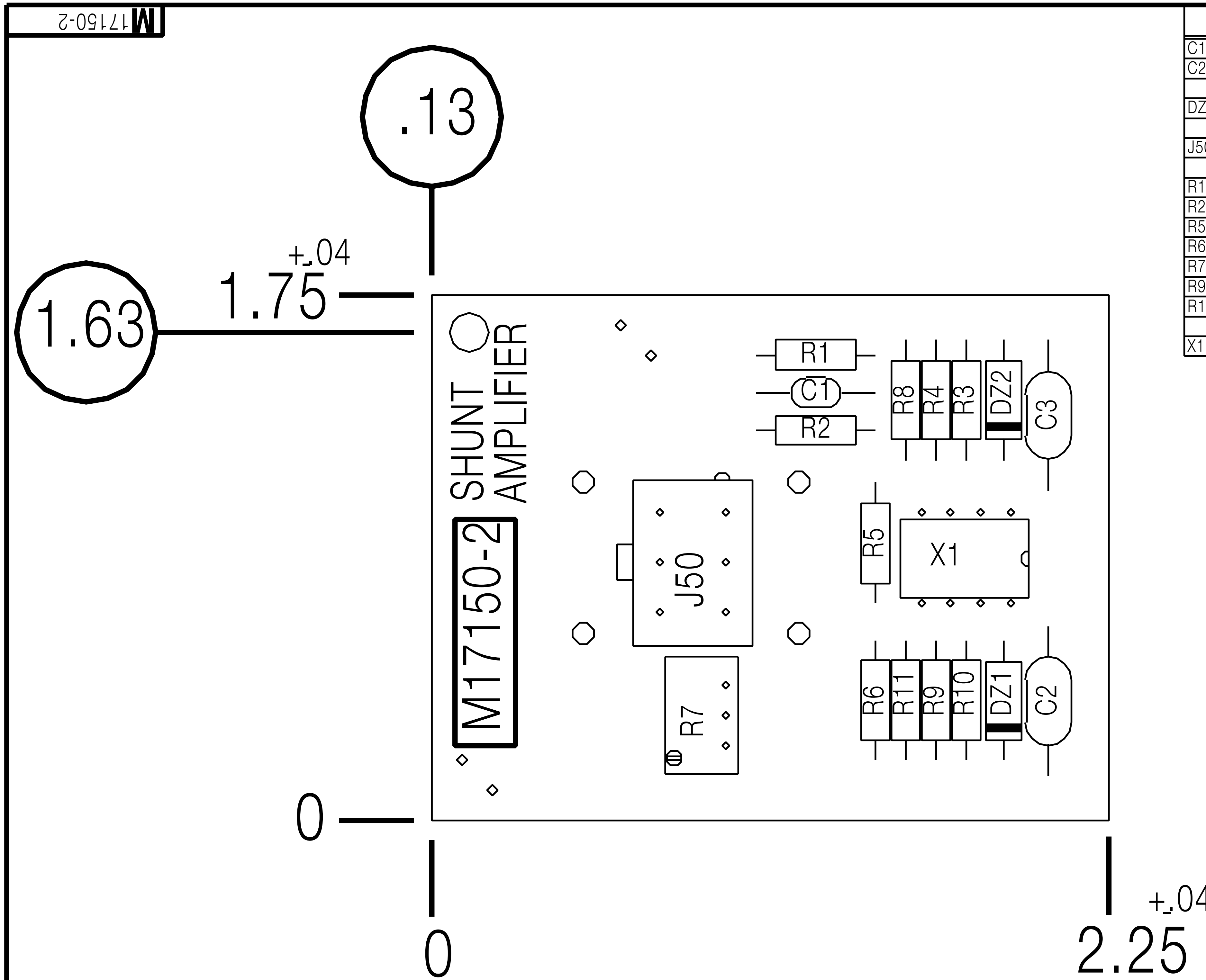
THE LINCOLN ELECTRIC CO.
CLEVELAND, OHIO U.S.A.

EQUIP. TYPE INVERTEC V400
SUBJECT SHUNT AMPLIFIER PCB SCHEM.
SCALE NONE
DR. DB DATE 2-7-94 CHK. SUP'S'D'G. SHT. NO. S 21151

NOTE: This diagram is for reference only. It may not be accurate for all machines covered by this manual.

Return to Section TOC
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PC BOARD ASSEMBLY- SHUNT



ITEM	REQ'D	PART NO	DESCRIPTION
C1	1	S16668-5	.022/50
C2,C3	2	S16668-11	.1/50
DZ1,DZ2	2	T12702-29	1N4744A
J50	1	S18248-6	HEADER
R1,R3	2	S19400-5110	511 1/4W
R2,R4	2	S19400-4751	4.75K
R5,R8	2	S19400-3923	392K 1/4W
R6	1	S19400-5620	562 1/4W
R7	1	S16296-3	500 1/2W TRIMMER
R9	1	S19400-1301	1.3K 1/4W
R10,R11	2	S19400-1000	100 1/4W
X1	1	S15128-13	PRECISION OP AMP IC

CAPACITORS = MFD/VOLTS

Ch'ge. Sht. No.
11-21-97G
4-20-2000D

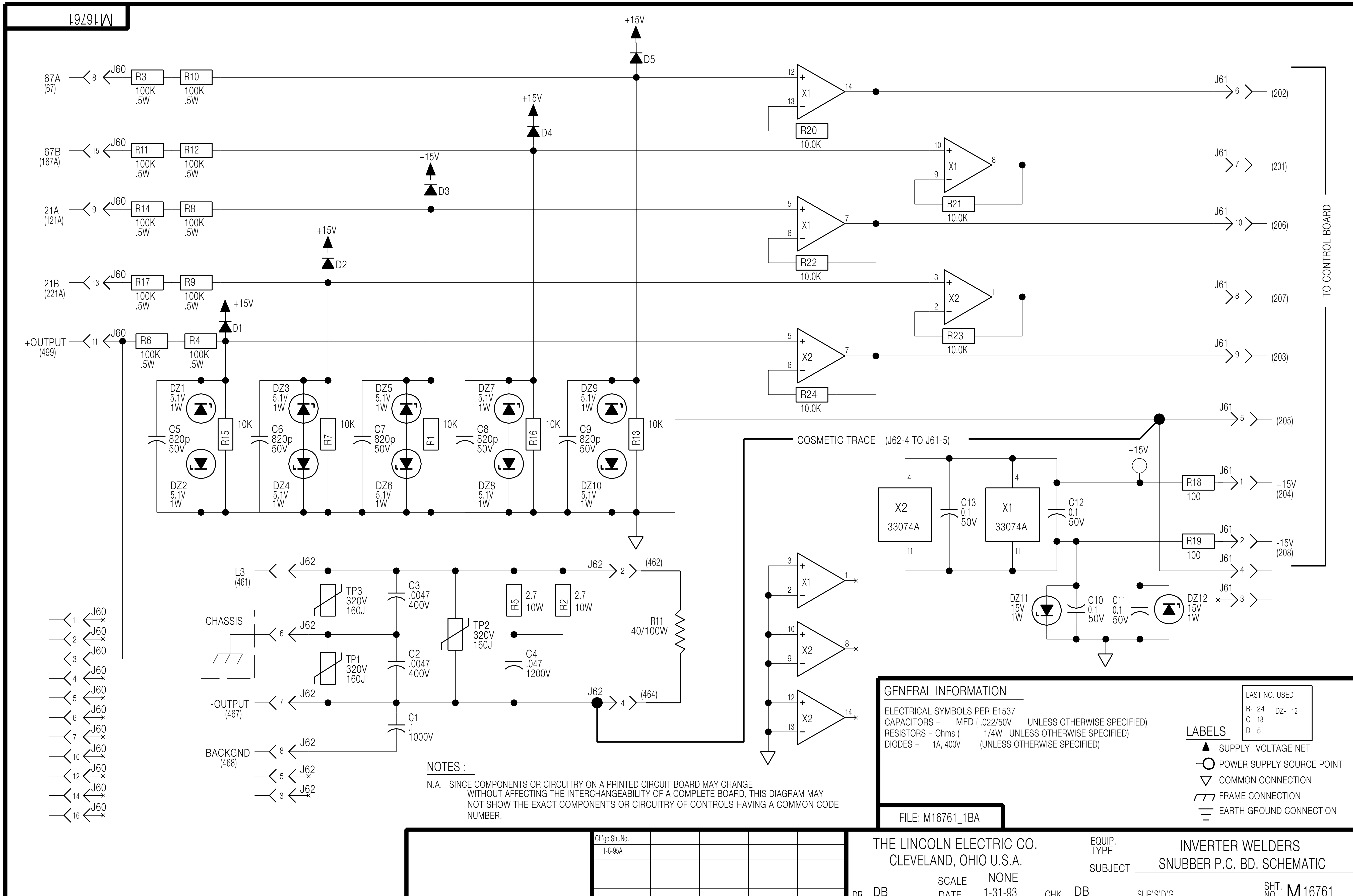
THE LINCOLN ELECTRIC CO.
CLEVELAND, OHIO U.S.A.

EQUIP. TYPE INVERTER WELDERS
SUBJECT SHUNT AMPLIFIER P.C. BD. ASSEMBLY
SCALE FULL
DR LJB DATE 11-4-97 CHK J.J. REF. M17150-1 SUP'S'D'G
SHT. NO. M 17150-2

NOTE: Lincoln Electric assumes no responsibility for liablilities resulting from board level troubleshooting. PC Board repairs will invalidate your factory warranty. **Individual Printed Circuit Board Components are not available from Lincoln Electric.** This information is provided for reference only. Lincoln Electric discourages board level troubleshooting and repair since it may compromise the quality of the design and may result in danger to the Machine Operator or Technician. Improper PC board repairs could result in damage to the machine.

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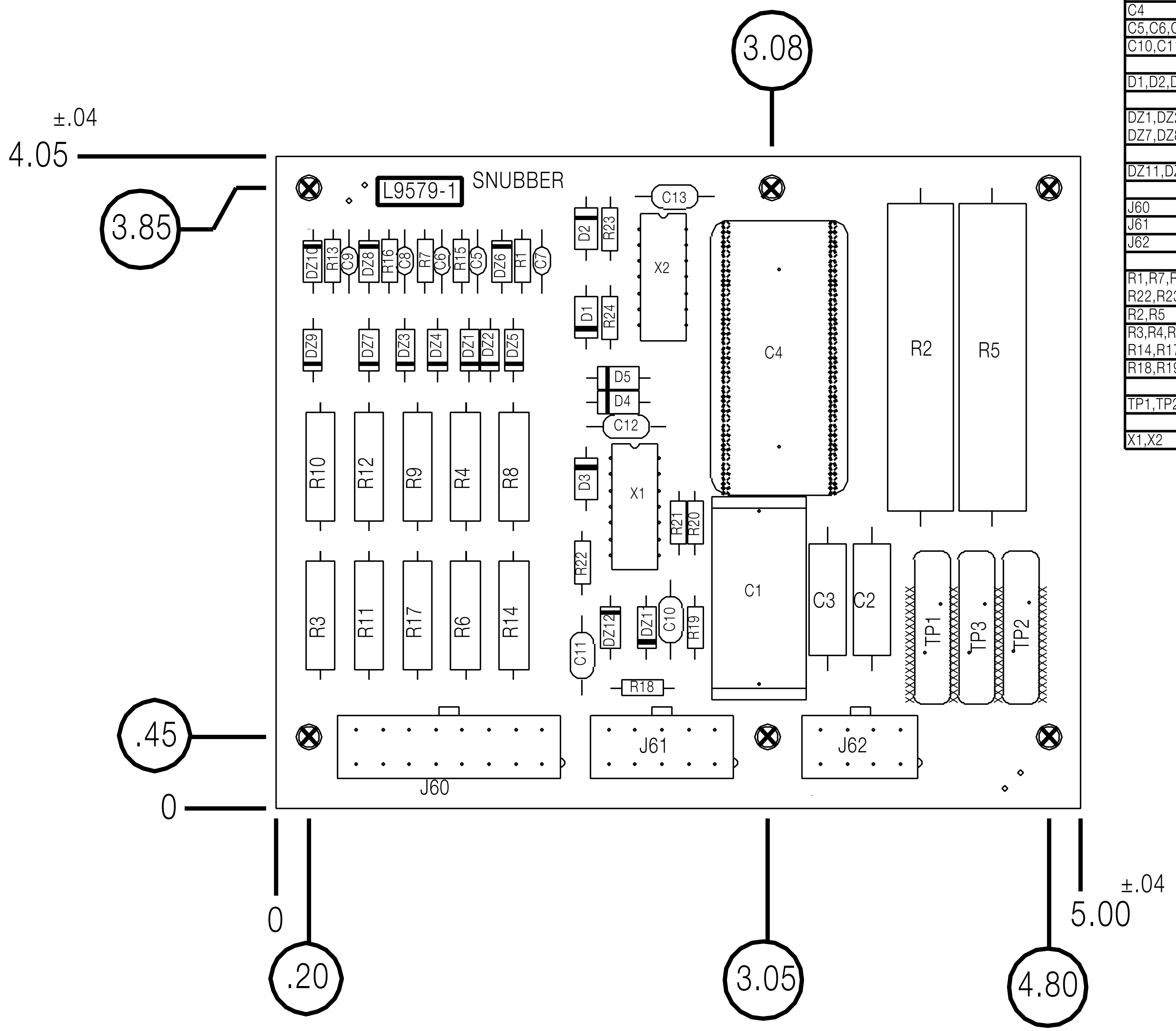
SCHEMATIC - SNUBBER PRINTED CIRCUIT BOARD



NOTE: This diagram is for reference only. It may not be accurate for all machines covered by this manual.

Return to Section TOC
Return to Master TOC

PC BOARD ASSEMBLY- SNUBBER



ITEM	REQ'D	PART NO.	IDENTIFICATION
C1	1	S20500-1	.1/1000
C2,C3	2	S13490-3	.0047/400
C4	1	S13490-112	.047/1200
C5,C6,C7,C8,C9	5	S16668-7	820pF/50
C10,C11,C12,C13	4	S16668-11	1/50
D1,D2,D3,D4,D5	5	T12199-1	1N4004
DZ1,DZ2,DZ3,DZ4,DZ5,DZ6 DZ7,DZ8,DZ9,DZ10	10	T12702-52	1N4733A
DZ11,DZ12	2	T12702-29	1N4744A
J60	1	S18248-16	HEADER
J61	1	S18248-10	HEADER
J62	1	S18248-8	CONNECTOR
R1,R7,R13,R15,R16,R20,R21 R22,R23,R24	10	S19400-1002	10K 1/4W
R2,R5	2	T14649-7	2.7 10W
R3,R4,R6,R8,R9,R10,R11,R12 R14,R17	10	S20620-1003	100K 1/2W
R18,R19	2	S19400-1000	100 1/4W
TP1,TP2,TP3	3	T13640-18	160J
X1,X2	2	S15128-18	QUAD-OP AMP

CAPACITORS = MFD/VOLTS

EQUIP. TYPE: INVERTER WELDERS
SUBJECT: SNUBBER P.C. BOARD ASSEMBLY
SHT. NO. L9579-1

THE LINCOLN ELECTRIC CO.
CLEVELAND, OHIO U.S.A.

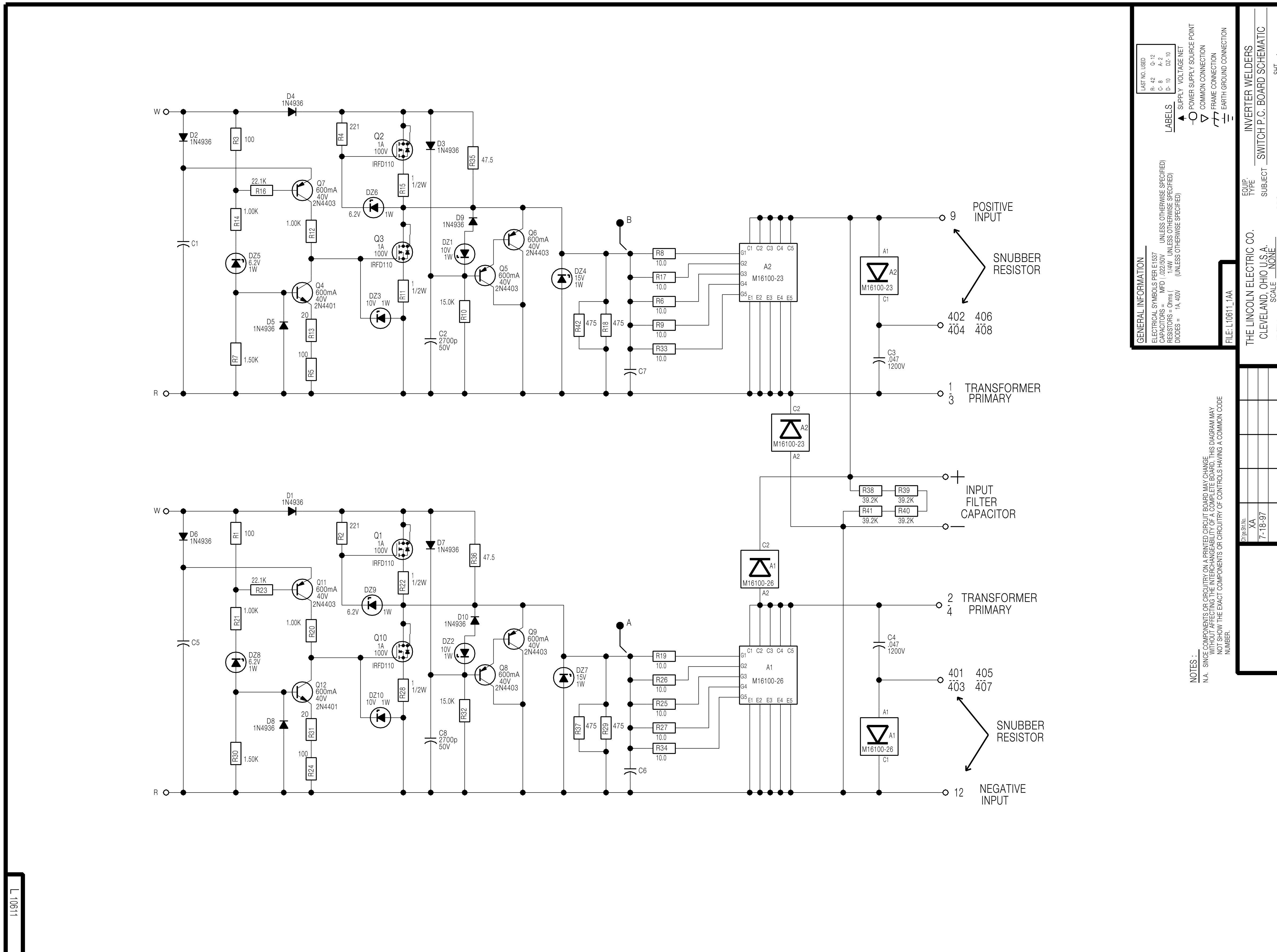
UNLESS OTHERWISE SPECIFIED TOLERANCE ON HOLE SIZES PER E2056 ON 2 PLACE DECIMALS IS ±.02 ON 3 PLACE DECIMALS IS ±.002 ON ALL ANGLES IS ±.5 OF A DEGREE MATERIAL TOLERANCE (" t ") TO AGREE WITH PUBLISHED STANDARDS.

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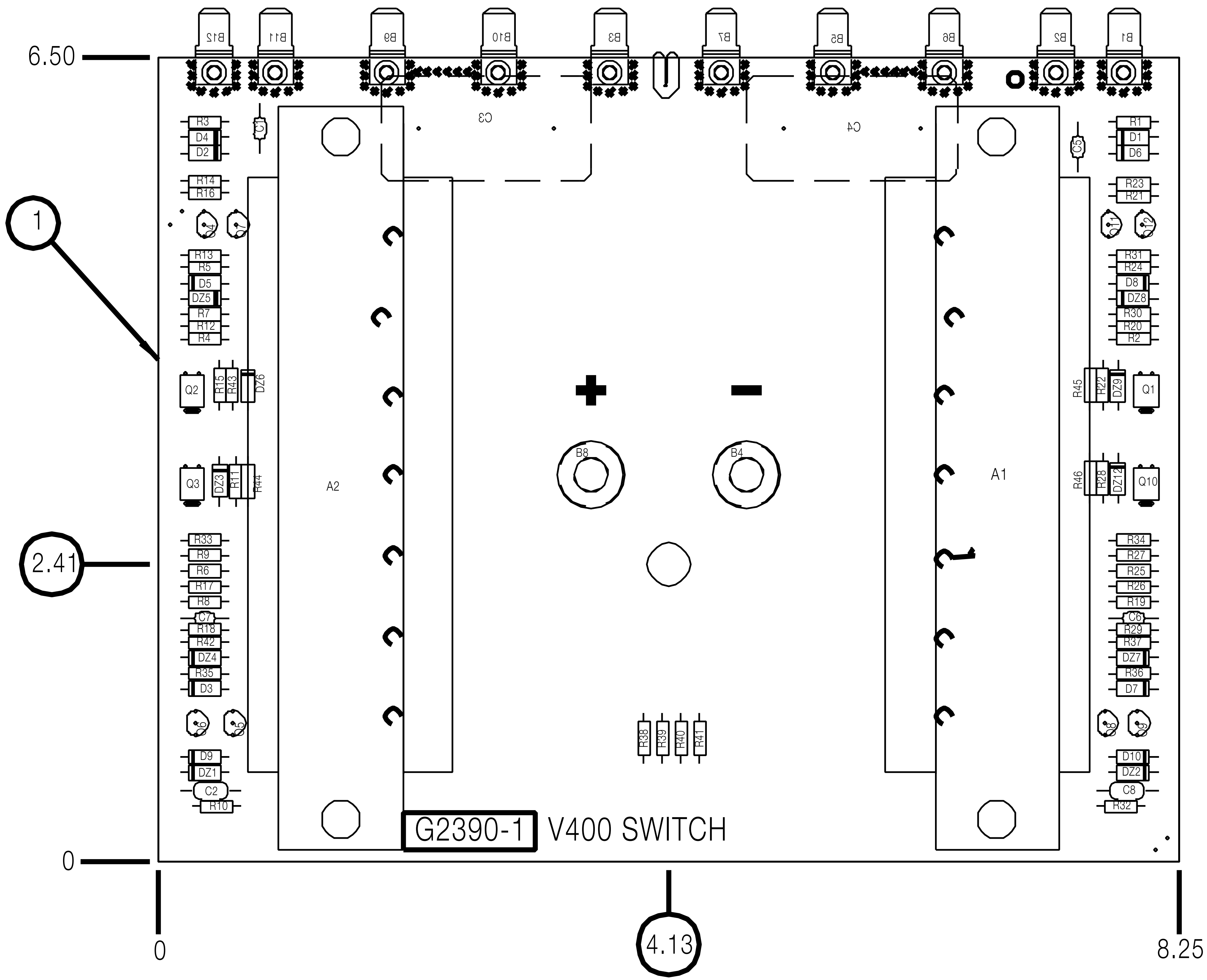
SCHEMATIC-SWITCH PRINTED CIRCUIT BOARD



NOTE: This diagram is for reference only. It may not be accurate for all machines covered by this manual.

Return to Section TOC
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PC BOARD ASSEMBLY-SWITCH



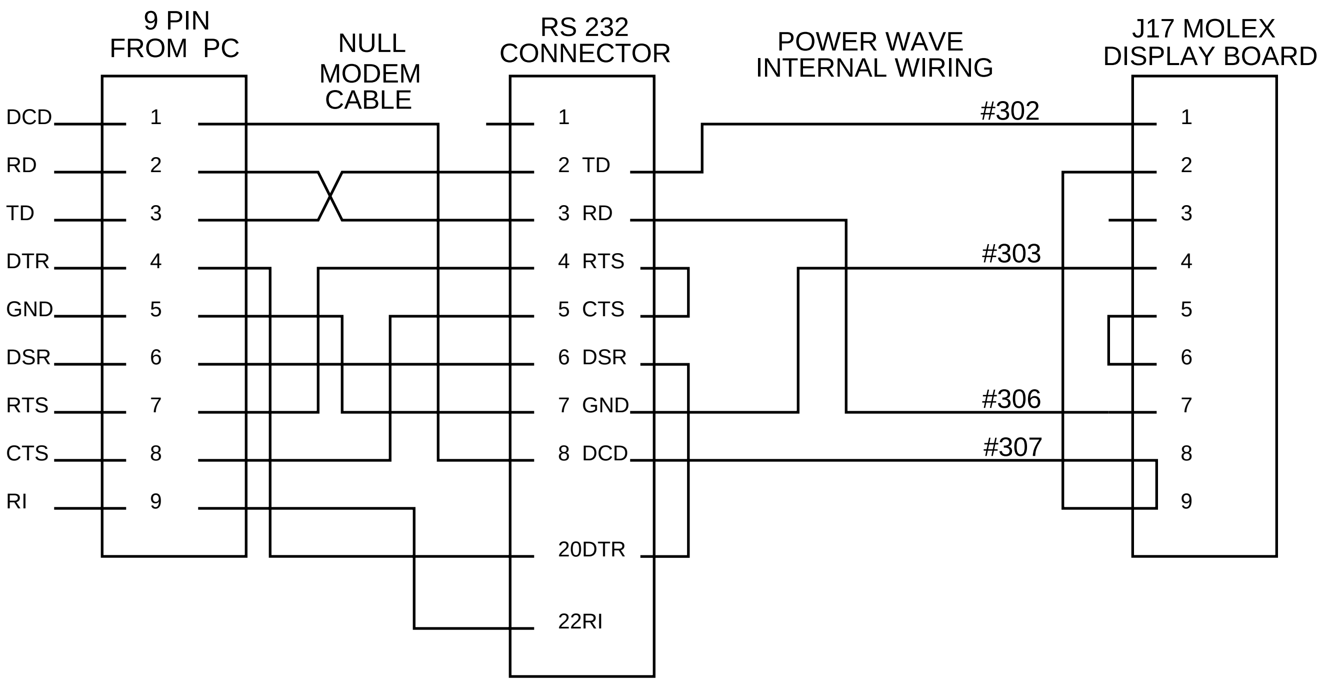
ITEM	REQ'D	PART NO.	DESCRIPTION
A1	1	M16100-8	ELECTRONIC MODULE (SS)
A2	1	M16100-7	ELECTRONIC MODULE (SS)
B1,B2,B3,B5,B6,B7,B9,B10 B11,B12	10	T13157-6	TAB TERMINAL
C1,C5,C6,C7	4	S16668-5	.022/50
C2,C8	2	S16668-4	2700pF/50
C3,C4	2	S13490-112	.047/1200
D1,D2,D3,D4,D5,D6,D7,D8,D9 D10	10	T12705-34	1N4936
DZ1,DZ2,DZ3,DZ12	4	T12702-27	1N4740
DZ4,DZ7	2	T12702-29	1N4744A
DZ5,DZ6,DZ8,DZ9	4	T12702-40	1N4735
Q1,Q2,Q3,Q10	4	T12704-73	IC PKG MOSFET (SS)
Q4,Q12	2	T12704-68	2N4401
Q5,Q6,Q7,Q8,Q9,Q11	6	T12704-69	2N4403
R1,R3,R5,R24	4	S19400-1000	100 1/4W
R2,R4	2	S19400-2210	221 1/4W
R6,R8,R9,R17,R19,R25,R26	10	S19400-10R0	10 1/4W
R27,R33,R34			
R38,R39,R40,R41	4	S19400-3922	39.2K 1/4W
R7,R30	2	S19400-1501	1.5K 1/4W
R10,R32	2	S19400-1502	15K 1/4W
R11,R15,R22,R28,R43,R44 R45,R46	8	S19400-2R00	2 1/4W
R12,R14,R20,R21	4	S19400-1001	1K 1/4W
R13,R31	2	S19400-20R0	20 1/4W
R16,R23	2	S19400-2212	22.1K 1/4W
R18,R29,R37,R42	4	S19400-4750	475 1/4W
R35,R36	2	S19400-47R5	47.5 1/4W

CAPACITORS = MFD/VOLTS
INDUCTANCE = HENRIES
RESISTANCE = OHMS

THE LINCOLN ELECTRIC CO. CLEVELAND, OHIO U.S.A.
EQUIP. TYPE: INVERTER WELDERS
SUBJECT: SWITCH P.C. BOARD ASSEMBLY
SCALE: FULL
DR: JLV DATE: 2-16-94 CHK: R.M. REF.: L8982-1 SUP'S'D'G:
SHT. NO. G 2390-1

NOTE: Lincoln Electric assumes no responsibility for liablilities resulting from board level troubleshooting. PC Board repairs will invalidate your factory warranty. **<u>Individual Printed Circuit Board Components are not available from Lincoln Electric.</u>** This information is provided for reference only. Lincoln Electric discourages board level troubleshooting and repair since it may compromise the quality of the design and may result in danger to the Machine Operator or Technician. Improper PC board repairs could result in damage to the machine.

POWER WAVE RS 232 CONNECTIONS



NOTE: Lincoln Electric assumes no responsibility for liabilities resulting from board level troubleshooting. PC Board repairs will invalidate your factory warranty. This Printed Circuit Board schematic is provided for reference only. It may not be totally applicable to your machine's specific PC board version. This diagram is intended to provide general information regarding PC board function. Lincoln Electric discourages board level troubleshooting and repair since it may compromise the quality of the design and may result in Danger to the Machine Operator or Technician. Improper PC board repairs could result in damage to the machine.

SVM ERROR REPORTING FORM

We need to know if there are errors in our manuals. We also value any suggestions as to additional tests or procedures that would make this SVM a better tool for you.

If you discover new or different "Problems or Symptoms" that are not covered in the three column troubleshooting chart, please share this information with us. Please include the machine's code number and how the problem was resolved.

Thank You,
Technical Services Group
Lincoln Electric Co.
22801 ST. Clair Ave.
Cleveland, Ohio 44117-1199

FAX 216-481-2309

SVM Number ____________________________

Page Number if necessary__________________

Your Company___________________________

Your Name______________________________

Please give detailed description below:

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